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CHEMICAL CHANGES IN THE BODY OCCURRING AS THE RESULT OF VOMITING*

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AND
FRANCIS SCOTT SMYTH, M.D.
WITH THE ASSISTANCE OF ANNA E. MOSER
ST. LOUIS

Although considerable attention has been given to the occurrence and significance of acidosis, it is only recently that changes of body neutrality to the alkaline side have received much notice.[1]

REVIEW OF THE LITERATURE

Wilson and his co-workers[2] were among the first to consider alkalosis as a possible cause of tetany. They found, following parathyroidectomy, that there was a slight increase in the p_H or alkalinity of the blood, a change in the hemoglobin dissociation curve and a rise in alveolar carbon dioxide tension. Accompanying these changes there was found also an increase in urinary p_H (alkalinity) with diminished ammonia and acid excretion. It was further assumed that with the onset of tetany, the acid products of muscular contraction were sufficient to change this primary increased alkalinity to a normal or more acid reaction.

In 1918, McCann[3] reported chemical analyses of the blood following parathyroidectomy, and in different animals after experimental gastric obstruction. Using Van Slyke's method for determining the carbon dioxide combining power of the plasma, he found this to be increased in both conditions, and concluded that tetany was a condition of alkalosis which in the case of gastric obstruction was brought about by exclusion of hydrochloric acid from the duodenum.

* Received for publication, March 1, 1926.

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1. During the writing of this paper, Gamble and Ross (J. Clin. Investigation **1**:403, 1925) have reported blood and urine chemistry changes in dogs after experimental pyloric obstruction. Their findings and conclusions are similar to ours as regards changes in the sodium chloride and bicarbonate content, but our interpretation of the rise in nonprotein nitrogen differs from theirs.

2. Wilson, D. W.; Stearns, T., and Thurlow, M. De G.: J. Biol. Chem. **23**: 89, 1915. Wilson, D. W.; Stearns, T., and Janny, J. H.: J. Biol. Chem. **23**:123, 1915.

3. McCann, W. S.: J. Biol. Chem. **35**:553, 1918.

H.L.B.

A more extensive study of gastric tetany was made by MacCallum.[4] In experimental pyloric obstruction in dogs, he found that the rise in plasma carbon dioxide content was accompanied by a fall in plasma chloride. He explained his findings on the basis of the loss of chloride by vomiting, a pronounced feature in the experimental dogs. This was further supported by the clinical improvement in the animals following administration of sodium chloride. After parathyroidectomy, however, MacCallum found no change in the alkali reserve; and he criticized the observations made by McCann because the latter's analyses had been made in one case after administration of magnesium sulphate and calcium chloride, in the other after gastric lavage, assuming that these factors might themselves alter the alkali reserve. Neither McCann nor MacCallum determined the p_H of the blood.

Hastings, Murray and Murray [5] repeated the experiments on dogs with pyloric obstruction, and verified MacCallum's findings of low blood chloride and high carbon dioxide content. In addition, they determined the exact reaction or p_H of the blood which they found normal or but slightly more alkaline than normal. From this it was assumed that alkalosis was not a constant factor.

Haden and Orr [6] have reported experiments on monkeys, dogs and rabbits with pyloric obstruction. The blood analyses were in agreement with those of MacCallum and his co-workers, but a different interpretation of the significance of the diminished chloride was given. In dogs, a fall in chloride was found before vomiting was marked. In rabbits and monkeys no vomiting occurred. They concluded that the loss of chloride was due to a fixation in the tissues of hydrochloric acid by a toxic substance. They believed that hydrochloric acid "detoxified" this hypothetic substance, and that the therapeutic efficiency of chloride administration was due to this effect. The rise in the blood nonprotein nitrogen encountered was explained by increased protein catabolism caused by this toxic agent.

Recently, Gamble,[7] by producing pyloric obstruction on rabbits, has shown that although these animals do not lose chlorides by vomiting, their stomachs contain quantities of hydrochloric acid and sodium chloride more than sufficient to account for the fall in blood chlorides. From this it would appear that instead of a migration of chlorides to the tissues from the blood, as Haden and Orr contend, a reverse migration takes place.

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4. MacCallum, W. G.; Lintz, J.; Vermily, H. N.; Boas, E., and Liggett, T. H.: Bull. Johns Hopkins Hosp. **31**:1, 1920.

5. Hastings, A. B.; Murray, C. D., and Murray, H. A.: J. Biol. Chem. **36**: 223, 1918.

6. Haden, R. L., and Orr, T. G.: J. Exper. Med. **37**:377, 1923.

7. Gamble, J. L.: Proc. Soc. Exper. Biol. & Med. **22**:365, 1924-1925.

Another form of alkalosis has been found to result from administration of sodium bicarbonate. Howland and Marriott [8] reported three cases of tetany in infants after treatment of acidosis by administration of sodium bicarbonate. Hardt and Rivers [9] demonstrated that alkalosis may result from the Sippy treatment in cases of duodenal ulcer. The reaction was more pronounced in patients showing some renal impairment, and they consider renal damage a very important factor. Harrop [10] found tetany developing in a patient with mercuric chloride poisoning when bicarbonate was given intravenously. The blood changes in all these cases were chiefly an increase in plasma carbon dioxide content. A rise in p_H was sometimes also encountered.

Brown and his co-workers [11] have reported eleven cases of duodenal obstruction, with blood analyses showing low chloride, high carbon dioxide and high nonprotein nitrogen. The phenolsulphonphthalein test showed a delayed renal excretion, and they concluded that in addition to the tetany manifestations there was a definite "duodenal toxemia" producing nephritis. This would appear to be similar in many respects to the toxic nephritis demonstrated by MacQuarrie and Whipple,[12] resulting apparently from toxic proteose formed in the ligated intestinal loop.

Tileston and Underhill [13] found an abnormally high plasma carbon dioxide content in three cases of tetany. In one case the administration of sodium bicarbonate could explain the finding. In the other two cases the causes were obscure; vomiting was not a feature, and there was no evidence of renal impairment. However, no nonprotein nitrogen or chloride determinations were made.

Ellis [14] reported "alkalemia" in four cases, two of which resulted from sodium bicarbonate administration; two from high intestinal obstruction. In one case the p_H reached 7.6, the carbon dioxide 119 per cent by volume. The plasma chloride was quite low and urea and phosphate were considerably increased. A fifth case of low intestinal obstruction showed high urea and low chlorides, but the p_H and carbon dioxide were unchanged. This patient showed an increased muscular irritability. At necropsy, some evidence of renal damage was found. In another of Ellis' cases a high urea was found without evidence of renal damage. He pointed out the danger of interpreting

8. Howland, J., and Marriott, W. McK.: Quart. J. Med. **11**:289, 1917-1918.
9. Hardt, L. L., and Rivers, A. B.: Toxic Manifestations Following the Alkaline Treatment of Peptic Ulcer, Arch. Int. Med. **31**:171 (Feb.) 1923.
10. Harrop, G. A.: Bull. Johns Hopkins Hosp. **30**:62, 1919.
11. Brown, G. E.; Eustermann, G. B.; Hartman, H. R., and Rowntree, L. G.: Toxic Nephritis in Pyloric and Duodenal Obstruction, Arch. Int. Med. **32**:425 (Sept.) 1923.
12. MacQuarrie, I., and Whipple, G. H.: J. Exper. Med. **29**:421, 1919.
13. Tileston, W., and Underhill, F. P.: Am. J. M. Sc. **165**:625, 1923.
14. Ellis, W.: Quart. J. Med. Sc. **17**:405, 1923-1924.

a high urea as indicative of renal injury, and suggested that there might be a different explanation of increased urea when associated with a fall in chloride. He advanced the theory that anoxemia may account for the "alkalemia" as well as for the ketonuria in the presence of alkalemia resulting from sodium bicarbonate administration. McVicar [15] reported in tabular form, giving blood chemistry data, thirty cases of toxemia occurring following high intestinal obstruction. Three cases were discussed in more detail. An attempt was made to establish a connection between the manifestations of "toxemia," and alterations in the chemical composition of the blood. It was concluded that the changes were of value in diagnosing, in judging the severity and in following the efficacy of treatment in such cases.

Grant and Goldman,[16] and Collip and Backus [17] have shown that a shift in body neutrality may occur from forced respiration. In such an event the carbon dioxide is washed out of the blood by overventilation and the alkalinity of the blood increases; the urine becomes alkaline, and the excretion of ammonia is decreased. MacCallum [4] pointed out that this condition is analogous to that of gastric tetany. In the former, the carbonic acid is too rapidly removed from the body; in gastric tetany, it is the hydrochloric acid which is too rapidly removed.

Van Slyke [18] was among the first to show the stability of body neutrality; that an increase in plasma carbon dioxide content was ordinarily quickly compensated for, with no marked change in the reaction (p_H). The various mechanisms of respiration and renal function controlling the chemical neutrality of the body have been reviewed by Wilson.[19]

From this brief review of the literature, it is evident that there is still a considerable difference of opinion, particularly as to the significance of the fall in plasma chloride; whether it is dependent on vomiting, as has been generally supposed, or whether, as Haden and Orr conclude, there has been merely a migration from the plasma into the tissues. Difference of opinion also exists as to the relationship between tetany and alkalosis, since in some cases of intestinal obstruction with high plasma bicarbonate values, a normal or only slightly increased alkalinity (p_H) was found. There have also been different views as to the cause of the high blood nonprotein nitrogen values often found. Some workers attributed the elevation to renal impairment, others to increased protein catabolism, presumably the result of absorption of toxin, and still others to anhydremia, and only one worker, Ellis, really raises the question as to its real significance.

15. McVicar, C. S.: Am. J. M. Sc. **169**:224, 1925.
16. Grant, S. B., and Goldman, A.: Am. J. Physiol. **52**:209, 1920.
17. Collip, J. B., and Backus, P. L.: Am. J. Physiol. **51**:568, 1920.
18. Van Slyke, D. D.: J. Biol. Chem. **48**:153, 1921.
19. Wilson, D. W.: Physiol. Rev. **3**:295, 1923.

Since vomiting is such a frequent occurrence in infants and children, and results from nonmechanical as well as obstructive causes, we felt that it might be of interest to study such cases from the standpoint chiefly of changes in blood and urine chemistry and to attempt to throw more light on some of the points still in dispute.

In presenting our own data, we have found it convenient to arrange our cases in a number of groups. The first group (table 1, charts 1, 2 and 3) includes eleven cases of pyloric and high intestinal obstruction. The second group (table 2, chart 4) includes four cases of obstruction low in the small intestine. The third group (table 3, charts 5 and 3) includes three cases of marked vomiting not the result of obstruction. Table 4 and chart 6 show the results obtained on a case of intestinal fistula unaccompanied by vomiting. Table 5 and chart 7 include data obtained on an infant with severe pyelitis, who received sodium bicarbonate intravenously and later sodium chloride subcutaneously and by mouth.

In chart 8 are included McVicar's data on twenty-four cases of pyloric and high intestinal obstruction in adults.

METHODS

For the most part samples of blood were collected in a syringe containing oil, and were discharged under oil into graduated centrifuge tubes containing as anticoagulant, either neutral lithium citrate or potassium oxalate. Occasionally, serum from blood collected in a similar manner but without anticoagulant was used. The magnesium and phosphate determinations were made according to the method of Briggs.[20] The calcium determinations were sometimes made according to the method of Briggs,[20] and sometimes by the Tisdall modification of the Kramer-Tisdall method.[21] The sodium determinations were done according to the method of Kramer and Gittleman.[22] Results obtained for sodium values on citrated plasma are lower than those of either oxalated plasma or serum, and apparently are erroneous. The p_H determinations were made according to the method of Hastings and Sendroy.[23] The chloride determinations were made according to the method of Van Slyke.[24] The nonprotein nitrogen was determined by the micro-method of Folin-Wu;[25] the carbon dioxide content according to the method of Van Slyke,[26] and the glucose according to the

20. Briggs, A. P.: J. Biol. Chem. **59**:255, 1924.
21. Tisdall, F. F.: J. Biol. Chem. **56**:439, 1923.
22. Kramer, B., and Gittleman, L.: J. Biol. Chem. **62**:353, 1924.
23. Hastings, A. B., and Sendroy, J.: J. Biol. Chem. **61**:695, 1924.
24. Van Slyke, D. D.: J. Biol. Chem. **58**:523, 1923-1924.
25. Folin, O., and Wu, H.: J. Biol. Chem. **38**:81, 1919.
26. Van Slyke, D. D., and Cullen, G. E.: J. Biol. Chem. **30**:289, 1917.

method of Shaffer and Hartmann.[27] Serum protein was estimated by the refractometer, and lactic acid by the method of Clausen.[28]

PROTOCOLS

CASE 1 (table 1).—O. P., a girl, aged 8 years, during the previous four years had had frequent attacks of severe vomiting, usually ushered in by sudden abdominal cramps. The vomitus became bile tinged very early in the attacks, which were always afebrile. The duration of the intervals between attacks varied from only a few days to three months. When admitted to the hospital she had been vomiting everything for a week. She was extremely anhydremic: eyes sunken, skin dry, inelastic with a doughy feeling, and desquamating. She was very drowsy, but would respond to questions. She frequently complained of pain in the region of the umbilicus. The abdomen was scaphoid, without rigidity, visible peristalsis, or palpable masses. There was slight tenderness just above and to the right of the umbilicus. The respirations were regular but very slow and shallow. There was no muscular rigidity or positive sign of tetany. The blood and urine findings are noted in table 1. It was felt that the patient had a high intestinal obstruction. Fluid was forced in the form of saline solution, while the advisability of operation was considered. No improvement except for dilution of the blood was noted. A laparotomy was then performed and distention of the stomach and duodenum, with collapse of the small intestine and colon were noted. The duodenum was found to be pressed on by a long and very much thickened mesentery, just to the left of the spine. At this point there was an unusual amount of fibrous tissue in the mesentery and on the wall of the duodenum. A lateral anastomosis was made, but the child died just as the abdomen was closed. There was no necropsy.

CASE 2 (table 1).—P. S., a boy, was breast fed, and throve well for the first five weeks of life. He then began projectile vomiting of both food and water and was admitted to the hospital when 6 weeks old. During the first examination he was found to be markedly anhydremic and at times cyanotic, but no specific note of the respirations was made. After administration of water, typical gastric peristaltic waves were seen, followed by forceful vomiting. He was then operated on, and a very large pyloric tumor was found and split. Vomiting occurred for three days postoperative. On the third day after the nurse had observed that the infant was "acting peculiarly," the child stopped breathing. When stimulated by pulling out his tongue and squeezing his chest, he would breathe spontaneously for a while, and the cyanosis would disappear. Apnea would then recur. Just before the apneic pause, the eyes would roll upward, the hands become clenched and the lower extremities stiffened. The head was held retracted most of the time but without rigidity of the neck. During periods of relaxation, both the Chvostek and Trousseau signs of tetany were absent. The blood and urine chemistry, as will be noted in table 1, showed fairly marked deviation from the normal. Shallow breathing with apneic periods continued for the next three days, being especially noticeable while the infant was at the breast. On and after the fifth day postoperative, the breathing was normal.

CASE 3 (table 1, chart 1).—R. R., a boy, was breast fed, and did very well for the first three weeks of life. He then began to vomit, and the severity of the vomiting progressed until after two weeks all feedings were vomited in projectile fashion. During this period he was constipated and lost 3 pounds (1.4 Kg.). He was admitted to the hospital when 5 weeks old, at which time he was moderately undernourished and desiccated, and typical gastric peristaltic waves were seen. The temperature was normal. He was given whole lactic acid milk and Karo syrup feedings, preceded by $\frac{1}{480}$ grain of atropine. During the next

27. Shaffer, P. A., and Hartmann, A. F.: J. Biol. Chem. **45**:349, 1921.
28. Clausen, S. W.: J. Biol. Chem. **52**:263, 1922.

twenty-four hours he forcefully vomited all feedings. At this time there was general muscular hypertonicity, but no convulsions were ever observed. Both the Chvostek and Trousseau signs were negative. The blood and urine findings were as noted in table 1, showing very marked deviation from the normal. As a therapeutic measure the infant was fed tenth normal hydrochloric acid milk and operated on, a large muscular tumor being found and split. The infant made an uneventful recovery from the operation and ceased vomiting. One week later, when the breathing, blood and urine chemistry were normal, lactic acid milk feedings were again resumed.

Case 4 (table 1, chart 1).—L. B., a boy, artificially fed, aged 8 weeks, had done fairly well for the first seven weeks. He then began severe projectile vomiting, which was not relieved by thick feeding or by atropine. On the night before admission to the hospital, a critical period of cyanosis developed, from which the infant recovered. On admission, he was found to weigh 3,100 Gm., and was very slightly jaundiced. Gastric peristaltic waves were seen, but no tumor was felt. Laparotomy was performed shortly after admission. A large pyloric tumor was found and split. The abdomen was filled with physiologic sodium chloride solution before being closed. Immediately after operation the infant was very quiet. Soon, however, he became restless, crying when disturbed. The color became poor and the pulse was quite rapid. The temperature, which was 37.4 C. (99.4 F.) on admission, seven hours later reached 40 C. (104 F.). A grain of caffeine-sodiobenzoate was given subcutaneously and was repeated in four hours. The infant continued to cry considerably, apparently because of abdominal distention. Shortly after the second administration of caffeine, there were slow, convulsive movements of the arms and legs lasting for half an hour. Sixty cubic centimeters of 10 per cent glucose was given intravenously. At this time the infant appeared moribund.

Caffeine administration was continued, and a note was made that more severe convulsions followed each administration. Alternating with periods of excitement and convulsions, there were periods of marked lethargy, during which the pulse improved. Stimulation by caffeine and camphor was continued throughout the day following operation. Blood for chemical study was taken just twenty-four hours following operation (table 1). Shortly after this, 150 cc. of saline solution was given subcutaneously. Feedings were then well retained, convulsions ceased and caffeine and camphor administration was discontinued. Steady improvement followed, and the infant was discharged ten days following operation, gaining weight rapidly and without symptoms.

Case 5 (table 1, chart 1).—G., a boy, was observed from the time of birth (March 23, 1925). His birth weight was 3,330 Gm. He vomited from the time of his first feeding. On the third day, the rectal temperature reached 39 C. (102.2 F.), but was normal again the next day. The vomiting continued despite atropine and became projectile. The stools remained menconial in form. By the fifth day the infant had lost 440 Gm., and gastric peristaltic waves were seen. Blood was taken for study (table 1). Laparotomy was performed the next day, and a definitely thickened pylorus was found and split. Subcutaneous saline solution was given before operation and the day following. Before closure, the abdomen was filled with saline solution. The infant continued to vomit for four days following operation, and then made an uneventful recovery. The first stool containing milk appeared on the third day after operation.

Case 6 (table 1, chart 2).—V. E., a girl, was brought into the hospital when 22 days old, with a history of projectile vomiting since birth, and she had lost weight steadily. The stools were of the starvation type, dark and small. Examination revealed a gray, wasted, dried-out infant. When quiet, the respirations were slow and very shallow, with apneic periods. The Chvostek and Trousseau signs were absent. There was some muscular hypertonicity, however, on Feb. 14, 1925. The blood and urine chemistry is shown in table 1. Intestinal patterns and gastric peristaltic waves were observed and all feedings were vomited. Parenteral fluid as subcutaneous saline and intravenous glucose was given, and a laparotomy

TABLE 1.—*Cases of Pyloric and High Intestinal Obstruction*

Case and Name	Date	Plasma								Whole Blood				Urine					Therapy—Remarks					
		Sodium Chloride, Mg.	Carbon Dioxide, per Cent by Vol.	Ph	Calcium, Mg.	Magnesium, Mg.	Sodium,* Mg.	Phosphorus, Mg.	Protein, per Cent	Nonprotein Nitrogen, Mg.	Glucose, Mg.	Lactic Acid, Mg.	Cell Volume, per Cent	Ph	Brom Cresol Purple Reaction	Litmus Reaction	Chloride Reaction	Ammonia Reaction	0.85% Sodium Chloride, Mg.	10 to 20% Glucose, Mg.	Citrated Whole Blood, Cc.	0.1 N Hydrochloric Acid Milk, Cc.	Tetany	8% Magnesium Sulphate	
	1923																		1,500						
1	3/29	...	72.0	....	....	....	...	...	....	152	...	....	....	....	....	...	....	....	1,500	350	...	....	....	30	
O. P.	3/30	435	86.5	....	....	....	...	...	....	....	...	....	....	....	Neutral	...	0	....	1,000	...	...	..	..	..	Operation
	3/31	350	70.8	....	....	....	...	...	....	61.4	...	....	....	....	Acid	...	0	....							Died
																			400	...	...	....	....	..	Operation
2	12/17	...	....	....	....	....	...	...	....	....	...	....	....	....	....	....	....	....	100	...	...	....	++	..	
P. S.	12/20	...	86.0	....	....	....	...	...	....	....	114	22.9	....	....	....	Alk.	0	+	..	...	...	....	....	..	
	12/21	...	80.0	....	....	....	...	...	....	37.2	...	....	....	....	....	Alk.	....	....	..	...	...	....	....	..	
	12/24	...	....	....	....	....	...	...	....	....	...	....	....	....	Alk.	Acid	....	....	...	...	...	....	....	..	Recovered
	12/26	...	....	....	....	....	...	...	....	....	...	....	....	....	Alk.	Acid	....	....	...	...	...	....	....	..	
	1924																		500	...	...	....	....	..	
3	4/30	...	....	....	....	..	...	..	....	....	...	....	....	....	....	....	....	....	600	75	...	Started	....	..	
R. R.	5/ 1	351	134.0	....	....	....	...	...	....	116	...	....	....	....	Alk.	Alk.	....	....	...	...	...	....	....	..	
	5/ 3	505	110.0	....	....	....	...	...	....	80	...	....	....	....	Neutral	Acid	....	....	200	...	...	....	....	..	Operation
	5/ 5	...	....	....	....	....	...	...	....	....	...	....	....	....	....	Acid	....	....	...	...	...	....	....	..	
	5/ 6	...	....	....	....	....	...	...	....	....	...	....	....	....	....	Alk.	....	....	...	...	...	Discon-	....	..	Recovered
	5/ 9	508	59.0	....	....	....	...	...	....	....	...	....	....	....	....	....	....	....	...	...	...	tinued	....	..	
																							++	..	Operation
4	5/26	...	....	....	....	....	...	...	....	....	...	....	....	....	....	....	....	....	...	...	...	....	....	..	Recovered
L. B.	5/27	445	61.7	....	....	....	...	...	....	40.8	...	....	....	....	....	....	....	....	...	...	...	....	....	..	
	1925																		...	...	...	....	....	..	
5	3/27	516	59.0	7.52	....	...	...	...	....	71.0	...	....	....	6.0	....	...	0	0	300	...	...	....	....	..	Operation
G.	5/28	...	....	....	....	....	...	...	....	....	...	....	....	....	....	..	....	....	150	...	...	....	....	..	Recovered
	3/29	...	....	....	....	....	...	...	....	....	...	....	....	....	....	...	....	....							
														...	....	...	....	....	300	100	...	....	....	..	
6	2/13	298	110.0	7.40	10.6	3.5	156*	2.7	....	58.0	...	....	....	5.95	....	...	0	++	...	...	...	....	....	..	Operation
V. E.	9:15 p.m.		90.3	....	....	....	...	...	....	....	...	....	....	....	....	...	....	....	100	...	...	....	....	..	
	2/14	275	90.3	....	....	....	...	...	....	....	...	....	....	7.20	....	...	++	+	200	100	...	....	....	..	
	2/15	...	....	...	..	....	...	..	....	....	...	....	....	6.60	....	...	++	F.tr.	200	100	...	....	....	..	
	2/16	...	....	....	....	....	...	...	....	....	...	....	....	6.60	....	...	V. F.tr.	0	...	...	...	....	....	..	
	2/17	497	89.2	....	....	..	...	...	....	....	...	....	....	7.00	....	...	....	....	...	...	...	....	....	..	
	2/18	...	....	....	....	....	...	...	....	....	...	....	....	6.40											

	2/19	. .	....	....	....	...	...	...	....	....	...	....	....	7.60	....	...	++	0	150	...	70	....	....	..	
														7.60											
														7.20											
	2/20	503	92.0	....	....	...	...	...	....	....	...	....	....	6.30	....	...	+	Tr.	...	...	...	....	....	..	
														6.90	....	...	+	Tr.	...	...	...	....	....	..	
														6.80	....	...	+	Tr.	...	...	...	....	....	..	
														6.90											
	2/21	...	...	....	....	...	...	...	....	....	...	....	....	....	....	...	....	....	200	...	...	....	....	..	
	2/22	...	72.0	....	....	...	...	...	....	....	...	....	....	....	....	...	....	....	200	100	...	....	....	..	
	2/23-3/3	444	67.0	....	....	...	...	...	....	....	...	....	....	....	....	...	....	....	200	100	...	....	....	..	
														....	....	...	....	....	1,700	280	...	....	....	..	Died
7	6/ 3	415	81.0	7.55	....	...	...	...	....	44.6	123	....	....	....	....	...	....	....	300	...	...	....	....	..	
B. M.	6/ 4																								
	a.m.	431	63.0	7.45	9.0	...	...	...	....	33.2	...	....	....	7.38	....	...	0	V.F.tr.	...	...	...	....	....	..	
														7.80	....	...	V.F.tr.	V.F.tr.	...	...	80	....	....	..	
	p.m.	...	....	....	11.5†	1.9†	207†	...	....	....	...	....	....	6.85	....	...	V.F.tr.	V.F.tr.	...	...	...	....	....	..	
	6/ 5	...	....	....	....	...	...	...	....	....	...	....	....	6.80	....	...	V.F.tr.	F.tr.	450	...	...	....	....	..	Operation
	6/ 6	...	....	....	....	...	...	...	....	....	...	....	....	....	....	...	....	....	250	...	...	....	....	..	
																									Died
8	6/26	302	76.5	....	....	...	230*	...	....	46.0	...	....	....	....	....	...	....	....	350	...	...	....	....	..	
N.	6/27	...	....	....	....	...	...	...	....	....	...	....	....	....	Neutral	...	0	+	...	...	...	....	....	..	Operation
	6/28	...	....	....	....	...	...	...	....	....	...	....	....	....	Neurtal	...	0	+	200	...	...	....	....	..	
	6/29	573	77.3	7.48	....	...	313*	...	....	....	...	....	....	....	Alk.	...	++	+	...	...	...	....	....	..	Recovered
9 M.	6/28	417	90.8	....	....	...	...	...	....	46.2	...	....	....	....	....	...	....	....	...	...	...	....	....	..	Recovered
10	7/ 7	439	73.0	....	14.5	3.0	208*	6.3	....	51.0	96	....	45.0	....	Alk.	Acid	0	+++	250	...	...	....	....	..	
P.	7/ 8	731	56.5	....	....	3.3	360*	3.6	....	52.0	122	....	33.3	....	Alk.	Alk.	+++	+++	200	...	100	....	....	..	
	7/ 9	...	....	....	....	...	...	...	....	....	...	....	....	....	Alk.	Alk.	+++	++	...	...	...	....	....	..	Operation
	7/10	574	46.4	7.47	12.7	2.8	380*	4.8	....	48.0	96	....	32.8	....	Alk.	Alk.	+++	++	...	...	...	....	++++	..	Recovered
11	12/ 2	492	92.0	7.73	14.9	...	370*	...	6.66	38.4	82	....	32.7	8.0	Alk.	Alk.	++	0	325	...	...	....	....	..	
J. C.	12/ 3	491†	89.0†	7.68†	12.5†	...	300†	...	7.20	47.0	112	....	....	6.85	Alk.	...	++	+	400	200	...	....	....	..	Operation
	12/18	562	60.0	7.53	12.3	...	...	...	6.01	29.0	...	....	....	....	Acid	Acid	++	+++	775	...	155	....	....	..	Recovered

* The starred sodium determinations were made on lithium citrated plasma, the others on oxalated plasma or serum.
† Serum.

was performed on the second day. An anomaly of the relation of the pancreas and duodenum was found. The pancreas embedded and constricted the duodenum, its duct entering into the anterior aspect of the bowel, the whole of which had a mesentery. In addition, there were extensive loose, veil-like adhesions binding both small and large bowel, some of which were broken up. Otherwise no further operation was attempted. The infant continued to vomit, and died nineteen days after admission. There was no healing of the abdominal wound.

Case 7 (table 1, chart 1).—B. M., a boy, was admitted when 6 weeks of age, with a history of vomiting since the fifth day. The vomiting had occurred during breast feeding, was projectile in type and voluminous. Refeeding, complementary thick formulas and atropine were without effect. Since the second week, constipation had been a marked symptom, and the weight had remained practically stationary. Birth weight, 2,780 Gm.; the weight on admission to hospital was 2,620 Gm. There were typical gastric peristaltic waves, and a pyloric tumor was

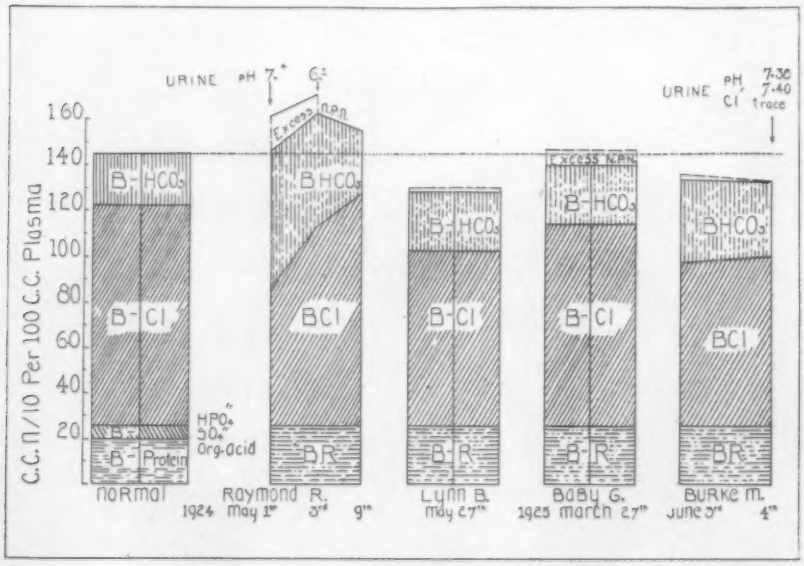

Chart 1.—Pyloric and high intestinal obstruction.

palpable. The respirations were very shallow and long apneic periods occurred irregularly. A febrile temperature persisted during the first three days, which could not be explained by any obvious infection. There was a decided hypertonicity of the musculature and frequent jerking movements were observed. The reflexes were very active, but the Chvostek and Trousseau signs were not elicited. The Ramstedt operation was performed, and a definite hypertrophic pylorus was found. Following operation, saline and intravenous glucose transfusions were given as therapeutic measures. The patient eventually died of peritonitis.

Case 8 (table 1, chart 2).—N., a boy, aged 1 month, was breast fed from birth. He began vomiting ten days before admission to the hospital (June 26, 1925), and the character of the vomiting suggested pyloric stenosis. During the ten days prior to admission the infant lost 650 Gm. in weight. On admission, the weight was 3,570 Gm. Respirations were of a depressed, irregular type with apneic periods. There was no muscular rigidity or other manifestation of tetany. Typical gastric peristaltic waves were seen, and a tumor mass was felt in the right upper quadrant. Laparotomy was performed on the day after admission. A

pyloric tumor was found and split, and the baby made an almost uneventful recovery. On admission, the temperature was 38.5 C. (101.2 F.). This fell gradually to normal during the first three days. No infection was found which accounted for this elevation in temperature.

Case 9 (table 1, chart 2).—M., a boy, aged 6 weeks, began to vomit ten days before admission to hospital. Constipation and loss of weight were associated with this vomiting, which became progressively more severe. He was admitted to hospital, June 27, 1925. Only a single blood determination was obtained, at which time the baby showed the characteristic depressed breathing after a crying spell. At that time the extremities were rigid and the Chvostek sign was negative. The baby was operated on three days after admission. A hard, thick pyloric tumor was found and split During the first seven days the temperature fluctuated between 38 and 40.5 C. (100.4 to 104.8 F.). The infant did not appear infected, and no focus of infection was found which could explain this fever. During convales-

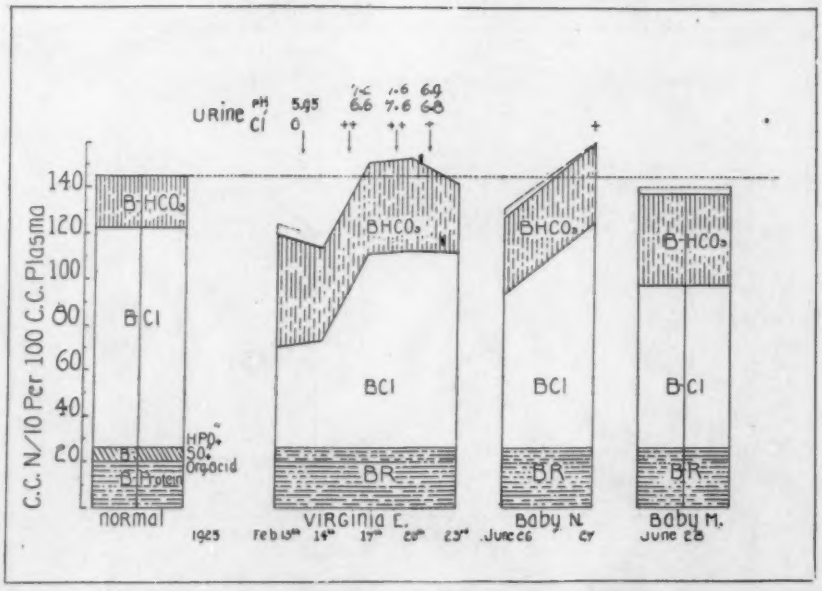

Chart 2.—Pyloric and high intestinal obstruction.

cence, however, otitis media developed, which somewhat prolonged the stay in the hospital. Eventually, the infant completely recovered.

Case 10 (table 1, chart 3).—P., a boy, aged 8 weeks, began vomiting when he was 3 weeks old, which became progressively more severe until admission to hospital on July 7, 1925. At times the breathing was markedly depressed. Typical gastric peristaltic waves were seen and a tumor was felt. Before operation, as a preparatory measure, the infant was given saline injections and a blood transfusion, and operation was performed two days after admission. A pyloric tumor was found and split. On the day following operation, there developed marked muscular rigidity and frequent clonic convulsions, without fever. Previous to this, the temperature had fluctuated from normal to 42 C. (107.6 F.) without any apparent infectious basis. After the administration of intravenous calcium chloride, the convulsions ceased. They began again, however, about six hours later, when they were again controlled by intravenous calcium chloride. Subsequently, the child made an uneventful recovery.

CASE 11 (table 1, chart 3).—J. C., a boy, aged 8 weeks, was admitted to the hospital Nov. 30, 1925. Vomiting began at 3 weeks of age, and became progressively more severe. Constipation and marked loss of weight were present. The administration of thick feeding and atropine resulted in temporary improvement, but the projectile vomiting recurred after a few days with the result that the patient lost 300 Gm. in weight in less than twenty-four hours. At this time, there was high fever, averaging around 39.5 C. (103 F.) without other evidence of infection and without leukocytosis. There was considerable anhydremia and general muscular hypertonicity. Respirations were depressed and irregular with long apneic pauses. Gastric peristaltic waves were plainly visible. Laparotomy was performed, and a fair sized tumor was found and split. The infant eventually made a complete recovery, although this was somewhat delayed because of unusually persistent vomiting following operation and because of fever which persisted for about two weeks. This fever during the first ten days could not be explained by infection. Later, however, otitis media developed.

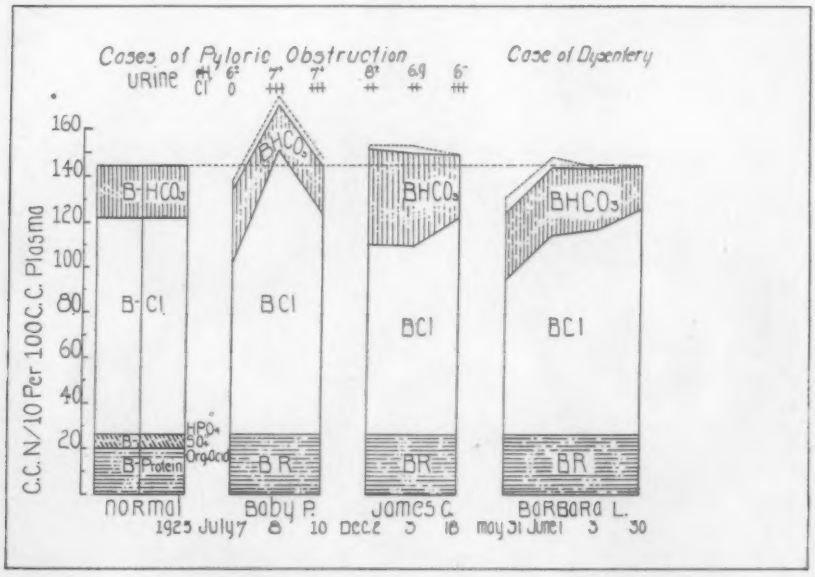

Chart 3.—Pyloric obstruction and one case of dysentery.

CASE 12 (table 2, chart 4).—L. H., was a negro girl, aged 12 years, whose illness apparently began about three months before admission to the hospital, with fever, productive cough and loss of weight. Five days before admission, abdominal pain developed, which was associated with constipation. Practically everything taken by mouth was vomited. One small stool was passed three days before admission. Examination revealed a moderately dehydrated, poorly nourished girl, with a rectal temperature of 39 C. (102.2 F.). Respirations were shallow, twenty-four per minute. An odor resembling that of acetone was detected on the breath. On the first day, the abdomen was slightly distended, tender, particularly in the right lower quadrant, and had a doughy feel. On the second day the leukocyte count was 30,200 with 76 per cent polymorphonuclears. An ineffectual enema, 1,000 cc. of physiologic sodium chloride solution subcutaneously and small amounts of water by mouth were given. The next morning there was marked distention of the abdomen with diffuse tenderness and rigidity, more on the right than on the left. Laparotomy revealed a markedly distended upper intestine with collapsed

TABLE 2.—*Cases of Lower Intestinal Obstruction*

Case and Name	Date	Plasma								Whole Blood				Urine					Therapy—Remarks					
		Sodium Chloride, Mg.	Carbon Dioxide, per Cent by Vol.	p_H	Calcium, Mg.	Magnesium, Mg.	Sodium,* Mg.	Phosphorus, Mg.	Protein, per Cent	Nonprotein Nitrogen, Mg.	Glucose, Mg.	Lactic Acid, Mg.	Cell Volume, per Cent	p_H	Brom Cresol Purple Reaction	Litmus Reaction	Chloride Reaction	Ammonia Reaction	0.85% Sodium Chloride, Mg.	10 to 20% Glucose, Mg.	Citrated Whole Blood, Mg.	0.1 N Hydrochloric Acid Milk, Cc.	Tetany	8% Magnesium Sulphate	
	1924																								
12 L. H.	5/17	...	51.0	....	....	...	...	...	....	....	...	....	....	....	....	...	....	....	1,000	...	...	....	....	..	
	5/17	422	63.1	....	....	...	...	...	....	148.0	...	.....	....	....	....	...	....	....	...	...	...	....	....	..	Operation Died
	1925																								
13 W.	1/30	538	60.0	7.40	....	3.2	274	1.9	....	63.2	110	16.3	....	....	....	...	....	....	...	...	...	Started	....	..	
	1/31	608	50.2	7.35	11.6†	5.9†	293	2.4†	....	40.4	...	41.5	....	....	....	...	....	....	240	...	...	Discontinued	....	..	Operation
	2/ 2	...	....	....	....	...	...	...	....	....	...	....	....	....	....	...	....	....	...	...	50	....	....	..	
	2/13	549	60.0	....	....	...	...	...	....	38.0	...	47.8	....	....	....	...	....	....	...	...	...	....	....	..	
	2/14	...	51.8	....	....	3.2	...	...	....	....	...	25.0	....	....	....	...	....	....	175	...	150	....	....	..	Recovered
14 S.	1/23	...	....	....	....	...	...	...	....	....	...	....	....	....	....	...	....	....	60	...	...	....	....	..	
	1/25	...	....	....	....	...	...	...	....	....	...	....	....	....	....	...	....	....	100	...	...	....	....	..	
	1/26	...	....	....	....	...	...	...	....	....	...	....	....	....	....	...	....	....	150	...	...	....	....	..	
	1/27	498	40.5	7.35	....	...	...	...	....	....	...	....	....	....	....	...	....	....	325	...	...	....	....	..	Operation
	1/28	...	....	....	....	...	...	...	....	....	...	....	....	....	....	...	....	....	150	...	...	....	....	..	Recovered
	2/14	...	50.2	....	....	...	...	...	....	....	...	....	....	....	....	...	....	....	...	...	...	....	....	..	
15 J. W.	7/27	586	59.5	7.38	12.1	3.7	236*	...	8.06	43.6	102	....	46.0	....	....	...	....	....	1,000	200	...	....	....	..	
	7/29	432	78.6	7.65	....	...	272*	...	....	40.0	128	....	50.0	....	Alk.	Alk.	0	++	...	...	...	....	....	..	
	7/31	374	62.0	....	10.6	3.2	258	12.0	8.28	36.0	122	....	46.2	....	Alk.	Alk.	0	++	500	200	...	....	....	..	
	8/ 1	...	....	....	....	...	...	...	....	....	...	....	....	....	....	...	....	....	450	200	...	....	....	..	Operation Died

* The starred sodium determinations were made on lithium citrated plasma, the others on oxalated plasma or serum.
† Serum.

ileum. At the junction of these two portions were two tuberculous ulcers, the lower one perforated. There was no free pus in the abdominal cavity, and the bowel at the site of the perforation apparently had been adherent to the parietal peritoneum. A few centimeters above the ulcers was a small intussusception, which apparently was causing the obstruction. This was reduced and the perforation closed. The child died shortly after leaving the operating table. Necropsy revealed widespread tuberculosis, and confirmed the laparotomy findings of tuberculous ulcers in the intestine. At the site of the previous intussusception in the jejunum, 120 cm. from the ligament of Treitz, there was an annular band of hemorrhage beneath the serosa, the mucosa being entirely intact. The peritoneal surface of that locality was covered with fibrin. In addition, there apparently was a definite narrowing of the pylorus caused by an adenoma in the smooth muscle tissue of the stomach wall near the pylorus. The history would lead one to suspect that the vomiting was not pyloric in origin, however, but associated with the perforation of the tuberculous ulcer and the intussusception.

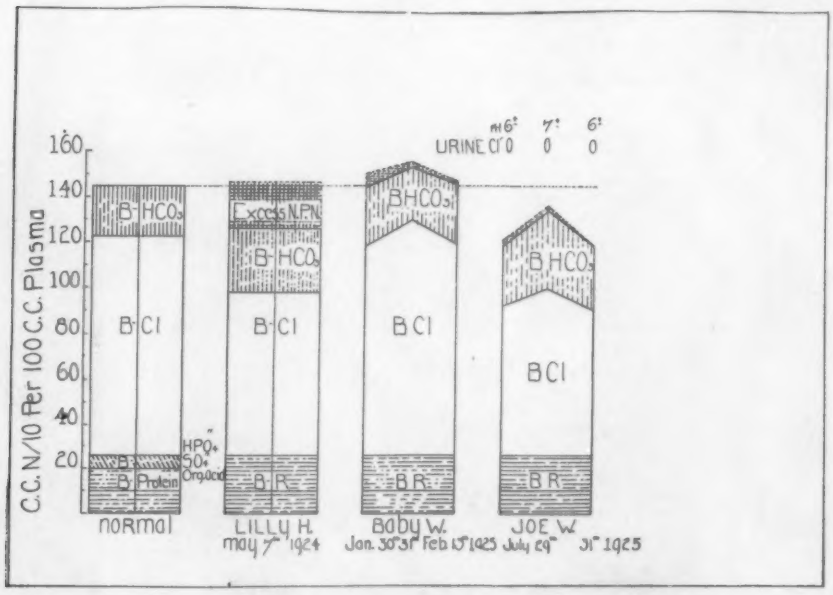

Chart 4.—Obstruction low in small intestine.

CASE 13 (table 2, chart 4).—W., a girl, premature, was breast fed for three weeks and then given a supplementary formula of lactic acid milk and karo syrup. During this time there was quite marked constipation. When 24 days old she began crying and straining, apparently with severe colic, and then she vomited. Vomiting continued and became projectile, occurring either during the feeding or shortly afterward. Constipation became more marked. She was brought to the hospital when 27 days old. She was found to be fairly well nourished and not dry, with a temperature of 36.3 C. (97.2 F.). During the first day in the hospital, she vomited most of her feedings and refeedings despite administration of atropine. Gastric lavage seemed to be of some benefit in controlling the vomiting, which at times was bile tinged. At intervals, the infant would cry as if from colic. When quiet, the respirations were distinctly depressed, and the urinary findings were as noted in table 2. Tenth-normal hydrochloric acid milk feedings were given during the next twenty-four hours. The vomiting and colicky attacks continued. An

inspiratory crow was often noticeable. Intestinal peristaltic waves were seen, and at times there were fibrillary twitchings and spastic contraction of the muscles of the abddominal wall. It was felt that there was a partial intestinal obstruction low in the small intestine, and that laparotomy was indicated, which was performed. The stomach was normal; the ileum as it entered the cecum was found to be adherent to the latter, and the ileocecal valve was constricted down to about one-fourth its normal diameter. A plastic operation, enlarging the ileocecal ring, was performed. Before closure of the abdomen, it was filled with saline solution. Vomiting gradually ceased and recovery followed. Two weeks after operation, accompanying an upper respiratory infection, there was vomiting for two days, which ceased as the infection subsided.

Case 14 (table 2).—S., a girl, was under our observation from birth (Jan. 19, 1925). Her birth weight was 3,540 Gm. She vomited from the time of the first feeding, the vomitus early becoming bile tinged. Intestinal patterns and gastric peristaltic waves were seen, but no tumor was felt. The first stool showing milk appeared on the fourth day. On the fifth day her weight dropped to 3,040 Gm. The rectal temperature up to this time varied from 37.4 C. to 37.9 C. (from 98.6 to 100.2 F.). The vomiting continued despite atropine. On the fifth, seventh, eighth and ninth days she was given saline solution subcutaneously. On the ninth day a laparotomy was performed. The pylorus was normal, but a clock-wise volvulus of the mesentery of the small bowel was found, with edema of the mesentery and enlarged glands. Both the duodenum and jejunum had an anomalous position and course. The volvulus was reduced. The abdomen was filled with saline solution and closed. Recovery was uneventful except for vomiting, which persisted for a few days. The birth weight was regained before the infant was 4 weeks old.

Case 15 (table 2, chart 4).—J. W., a boy, aged 12 years, had been operated on for acute appendicitis and local peritonitis two years previously. He was apparently well until six days before admission on July 27, 1925. During these six days vomiting, persistent constipation and abdominal pain were present. On the morning of admission he had five generalized convulsions, each preceded by irregularity of the respirations. On admission, he was found to be moderately anhydremic. Respirations when the child was asleep were distinctly depressed and irregular, and of the Cheyne-Stokes type; while awake the respirations were slow, shallow and even more irregular. The abdomen was full about the umbilicus, and an intestinal pattern was plainly visible. A roentgen-ray series of the gastro-intestinal tract confirmed the clinical impression of an intestinal obstruction low in the small intestine. A laparotmy was performed and fibrous bands were found to be obstructing the ileum. The child died shortly after the operation was completed.

Case 16 (table 3).—M. B., a girl, aged 2 years, was admitted to the hospital because of vomiting and diarrhea. She had done well until she was 20 months of age, when she developed pyelitis, which cleared up under the usual treatment, although somewhat slowly. A month later, on Dec. 18, 1923, she became ill, with vomiting and diarrhea. There seemed to be little or no fever. After eighteen hours, she became very thirsty and within a few hours was given several pints of water with added baking soda. She ceased vomiting, but developed two light convulsions of short duration. She was admitted to the hospital December 20, as having a case of "acidosis from vomiting," intravenous glucose and sodium bicarbonate being recommended as therapeutic procedures. She was found to be a sturdy infant, with a rectal temperature of 38.6 C. (101.4 F.). She lay quietly in bed, but was easily aroused. The respirations were regular but shallow. The remainder of the routine examination revealed nothing abnormal except hyperactive reflexes everywhere, but no Chvostek sign or carpopedal spasm. The leukocyte count was 7,200. The urine contained a few pus cells. After a few hours the temperature became elevated and the respirations irregular with apneic pauses. Frequent muscular twitchings were observed, involving particularly the hands and arms. Ten hours after admission there was a generalized convulsion. She was then given 10 cc. of 8 per cent anhydrous magnesium sulphate intramus-

cularly, and afterward had no more convulsions or muscular twitchings. The fever persisted for three days, gradually falling, coincident with a general improvement of the child's appearance. The leukocyte count dropped to as low as 5,000. On the fifth day after admission the patient was quite well, and was discharged.

CASE 17 (table 3, chart 5).—P. B., a girl, aged 8 months, was admitted to hospital, Oct. 27, 1924. She died, April 1, 1925. She had been apparently well until two weeks before admission, when she developed fever and began to vomit. She urinated frequently, and the urine was said to have a foul odor. Vomiting continued and became more marked, the patient becoming more listless, and eventually she was quite unconscious of her surroundings. The mother stated that the breathing had been irregular; "she would take two or three breaths and then stop." When admitted to the hospital she was found to have a temperature of 39.6 C. (103.2 F.). She was pale and slightly edematous, slightly cyanotic and semicomatose. Her respirations were slow, shallow and irregular with apneic pauses.

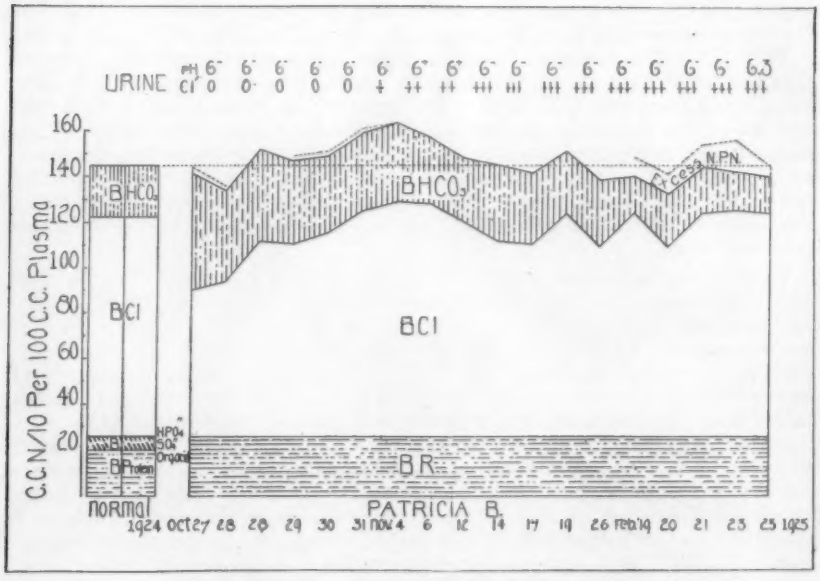

Chart 5.—Case of nonobstructive vomiting.

There was no muscular rigidity; instead, there was marked hypotonicity. Chvostek and Trousseau signs were negative. Both kidneys were easily palpable. The urine showed gross pus and teemed with bacteria (colon bacilli and staphylococci). The leukocyte count was 62,400. Methenamine and intravenous glucose, saline solution and blood transfusions were given. During the next three days, the edema increased markedly, the body weight increasing from 7,400 to 8,400 Gm. During the next twelve days there was an exacerbation of her vomiting, and at the same time copious diuresis, the edema disappeared and the weight fell from 8,400 Gm. on October 31, to 6,370 Gm. on November 11, at which time she had become actually anhydremic and required parenteral fluid. There was no diarrhea during this period. The striking changes in the blood and urine chemistry during this period can be seen in table 3. From that time until her death the picture was that of chronic infection, with periods of remission and exacerbation. It was found that there was a congenital stricture of the left ureter near the bladder, with hydro-ureter and hydronephrosis and infection in the kidney, ureter and bladder. Ureteral catheterization of the right ureter revealed

TABLE 3.—*Cases of Nonobstructive Vomiting*

Case and Name	Date	Plasma						Whole Blood			Urine					Therapy—Remarks					
		Sodium Chloride, Mg.	Carbon Dioxide, per Cent by Vol.	p_H	Magnesium, Mg.	Sodium, Mg.	Phosphorus, Mg.	Nonprotein Nitrogen, Mg.	Glucose, Mg.	Lactic Acid, Mg.	p_H	Brom Cresol Purple Reaction	Litmus Reaction	Chloride Reaction	Ammonia Reaction	0.85% Sodium Chloride, Cc.	10 to 20% Glucose, Cc.	Citrated Whole Blood, Cc.	Tetany	8% Magnesium Sulphate, Cc.	Termination
16	12/20/23	...	93.0	....	...	...	...	....	...	....	...	Alk.	Alk.*	+++	0	...	...	...	++++	10	
M. B.	12/22/23	...	....	....	...	...	...	....	...	....	...	Alk.	Alk.	....	....	...	...	...	....	..	
	12/23/23	...	....	....	...	...	...	....	...	....	...	Alk.	Neutral	....	....	...	...	...	....	..	Recovered
17	10/27/24	374	116.0	....	...	...	...	41.2	75	....	...	Acid	.....	0	+++	500	...	...	....	..	
P. B.	10/28/24	394	91.2	....	...	...	...	40.9	97	37.7	...	Acid	.....	0	+++	500	...	150	....	..	
	10/28/24	498	90.2	....	...	...	...	....	...	....	...	Acid	.....	0	+++	...	...	...	....	..	
	10/29/24	491	83.7	....	...	...	...	40.2	68	31.4	...	Acid	.....	0	+++	...	...	...	....	..	
	10/30/24	521	75.7	....	...	...	...	41.1	65	30.2	...	Acid	.....	0	+++	500	...	50	....	..	
	10/31/24	578	76.5	....	...	...	...	39.2	85	37.5	...	Acid	.....	+	+++	...	...	...	....	..	
	11/ 1/24	602	....	....	...	...	...	....	...	....	...	.....	.....	++	+++	...	100	...	....	..	
	11/ 4/24	603	78.2	....	...	...	...	27.2	62	31.5	...	Alk.	.....	++	+++	...	150	...	....	..	
	11/ 6/24	568	64.6	....	...	...	...	28.3	67	....	...	Alk.	.....	+++	++	...	...	100	....	..	
	11/12/24	550	61.8	....	...	...	...	37.2	70	....	...	Acid	.....	+++	++	400	...	100	....	..	
	11/14/24	527	68.2	....	...	...	...	37.4	97	....	...	Acid	.....	+++	++	700	200	...	....	..	
	11/17/24	524	59.5	....	...	...	...	29.4	67	15.3	...	Acid	.....	+++	++	850	200	...	....	..	
	11/19/24	573	60.3	....	...	...	...	28.6	97	30.0	...	Acid	.....	+++	++	500	...	125	....	..	
	11/21/24	506	....	....	...	...	...	31.4	79	....	...	Acid	.....	+++	++	...	...	135	....	..	
	11/26/24	509	55.5	....	...	...	1.5	32.8	85	....	...	Acid	.....	+++	++	1,800	...	...	....	..	
	12/29/24	561	....	....	...	...	...	....	...	....	...	.....	.....	.....	....	5,600	...	600	....	..	
	2/19/25	573	35.4	7.35	...	...	...	74.6	...	....	...	.....	.....	+++	++	600	100	500	....	..	
	2/20/25	515	43.3	7.45	...	...	...	76.0	189	....	...	.....	.....	+++	++	500	100	...	....	..	
	2/21/25	573	46.6	7.40	...	...	...	76.0	117	....	...	.....	.....	+++	++	500	100	100	....	..	
	2/23/25	585	36.6	7.30	...	...	4.4	102.0	130	....	6.30	.....	.....	+++	0	1,200	200	100	....	..	
	2/25/25	573	35.0	....	...	...	...	56.0	105	....	...	.....	.....	.....	....	2,000	200	...	....	..	
	4/ 1/25	...	69.0	7.50	1.5	338	3.8	....	...	66.8	...	.....	.....	.....	....	8,600	600	400	....	..	Died
18	5/31/25	405	66.8	7.50	...	...	...	66.0	...	....	...	.....	.....	.....	....	500	200	...	....	..	
B. L.	6/ 1/25	513	70.0	7.54	...	...	...	48.0	...	....	...	.....	.....	.....	....	300	...	100	....	..	
	6/ 3/25	534	58.0	7.48	...	...	...	32.8	...	....	...	.....	.....	.....	....	400	...	150	....	..	
	6/30/25	591	39.7	....	4.0	294	5.3	30.8	114	....	...	.....	.....	.....	....	3,050	175	200	....	..	

* Urine just alkaline to phenolphthalein

pyuria, although on this side there was no congenital anomaly and apparently only pyelitis. At times, there was marked clinical acidosis. Therapy consisted in feeding, parenteral saline solution, glucose and adult blood serum administration, blood transfusions, and methenamine and hexylresorcinol and local treatment of the bladder and kidney pelves. The patient eventually died from septicemia and meningitis, the organism being identical with that found in the urine. (This organism belonged to the *B. coli* group.) Before her death, coincident with the development of meningitis, there was marked pulmonary hyperventilation. Necropsy revealed no abnormality of the gastro-intestinal tract.

Case 18 (table 3, chart 3).—B. L., a girl, aged 2 years, was admitted to the hospital, May 31, 1925, in an extremely emaciated and anhydremic condition. Three weeks previously she had developed bacillary dysentery (Flexner type). At the onset she had four generalized convulsions, followed by severe vomiting and diarrhea. Two weeks later she developed bronchopneumonia, and during the week before admission she had several more convulsions. Diarrhea continued, but vomiting became less marked. For three weeks in the hospital she was quite prostrated. She received numerous injections of physiologic sodium chloride solution, glucose and whole citrated blood, and eventually recovered.

Case 19 (table 4, chart 6).—C. G., a negro boy, aged 11, was admitted to the hospital on July 14, 1925. Five months previously he had been operated on by a negro physician because of an intestinal intussusception, which was said to have been in the duodenum. Six weeks later, a second operation was performed because of a recurrence of symptoms. At that time adhesions were found to be causing partial intestinal obstruction. An enterostomy was performed, supposedly an ileostomy. A month or so later the patient developed an attack suggestive of localized peritonitis, recovering in a short time. About a month elapsed, during which he was free from symptoms, passing daily stools per rectum as well as intestinal material through the fistula. About a week before hospital admission, however, he ceased having normal stools, complained of abdominal cramps and frequently vomited.

On admission, he was found to be moderately emaciated and anhydremic with slight elevation of temperature. The respirations did not seem abnormal except for moderate hyperventilation associated with considerable apprehension during the early part of the examination (and shortly before the first blood sample was secured). The fistulous opening in the abdomen discharged a dark fluid material which was acid in reaction and which, as a rule, caused only little excoriation of the skin. A gastro-intestinal roentgen-ray study was made, which pointed to a high intestinal obstruction proximal to the enterostomy which seemed to be in the ileum. Before the examination was completed, both clinical symptoms and roentgen-ray findings of obstruction disappeared. A rubber tube, in part uniting the proximal and distal ends of the severed intestine, was inserted, and after a few days of observation the patient was discharged.

For a month he was free from symptoms, but during that time there were only two stools passed per rectum. He was again admitted on September 20 because of partial intestinal herniation through the fistulous abdominal opening. After reduction of the herniation, the hole in the intestine was gradually closed. Ringer's solution, subcutaneously, 20 per cent glucose in Ringer's solution with insulin added, intravenously, and blood transfusion were given at frequent intervals. The patient began to gain weight, and the discharge through the fistula became progressively less. For a short period there was a febrile attack, accompanied by abdominal cramps but no vomiting. At no time were there any manifestations of tetany or changes in respiration usually seen with alkalosis. The patient was discharged on November 7, with only a small amount of discharge from the fistula, and with daily normal stools per rectum.

Case 20 (table 5, chart 7).—A. W., a girl, well nourished, aged 8 months, became ill with fever one week before admission to the hospital on June 12, 1925. Pus was found in the urine, and sodium bicarbonate by mouth was prescribed. The elevation of temperature continued, however, and the urine maintained an

TABLE 4.—*Case of Fistula of the Small Intestine*

Plasma									Whole Blood			Urine					Therapy		
														Reaction					
Date	Sodium Chloride, Mg.	Carbon Dioxide, per Cent by Volume	p_H	Calcium, Mg.	Magnesium, Mg.	Sodium, Mg.*	Phosphate, Mg.	Protein, per Cent	Non-protein Nitrogen, Mg.	Glucose, Mg.	Cell Volume, per Cent	Date	Time	Methyl Red	Brom-Cresol Purple	Chloride	Ringer's tion, Cc.	20% Glucose in Ringer's, Cc.	Citrated Whole Blood, Cc.
												9/22/25	3:45 p.m. to						
9/23/25	450	76.6	7.32	9.8	2.5	310	6.7	8.06	38.6	120	44.6	9/23/25	6:00 a.m.	Acid	Acid	0	...	...	...
9/26/25	503	72.5	7.40	8.8	3.4	208	6.3	....	62.4	...	53.2	9/26/25	p.m.	Acid	Acid	0	...	...	200
												9/27/25	2:15 p.m.	Alk.	N	0	...	...	...
												9/27/25	8:00 p.m.	Alk.	N	0	...	225	...
9/28/25	404	74.6	....	10.8	2.3	238	9.4	....	76.4	...	50.0	9/28/25	6:00 a.m.	Acid	Acid	0	...	...	...
												9/28/25	6:30 p.m.	Alk.	Alk.	0	...	...	225
												9/29/25	6:00 a.m.	Acid	Acid	0	...	250	...
												9/29/25	1:45 p.m.	Alk.	Alk.	0	...	250	...
9/30/25	421	90.7	7.57	...	...	325	...	....	43.8	108	60.0	9/30/25	6:00 a.m.	Alk.	Alk.	0	...	250	...
																		Operation	
10/ 1/25	490	57.2	7.55	...	...	...	...	....	....	...	48.0	10/ 1/25	6:00 a.m.	Acid	Acid	0	500	250	...
10/ 2/25	527	78.6	7.50	8.5	2.1	...	6.9	....	40.6	96	50.0	10/ 2/25	6:00 a.m.	Acid	Acid	+	500	...	...
												10/ 3/25	12:00 a.m.	Alk.	N	+	...	...	...
												10/ 3/25	4:00 p.m.	Alk.	Alk.	+	...	...	...
												10/ 4/25	6:00 a.m.	Acid	Acid	V.F.t.	...	...	...
												10/ 4/25	6:30 p.m.	Alk.	Alk.	V.F.t.	...	200	...
												10/ 5/25	11:30 p.m.	Alk.	Alk.	V.F.t.	...	250	...
10/ 7/25	315	65.6	7.45	9.5	...	266	...	....	....	...	....	10/ 7/25	10:00 a.m.	Acid	Acid	V.F.t.	...	500	...
												10/ 8/25	12:00 p.m.	Alk.	Alk.	V.F.t.	...	250	...
												10/ 9/25	6:30 a.m.	Acid	Acid	0	...	...	...
												10/10/25	12:00 a.m.	Alk.	N	0	...	...	...
												10/10/25	4:10 p.m.	Acid	Acid	V.F.t.	...	...	...
												10/10/25	9:00 p.m.	Acid	Acid	0	...	...	...
10/11/25	506	64.8	7.58	...	...	248	...	....	....	..	....	10/11/25	5:00 p.m.	Alk.	Alk.*	+	...	...	300
												10/13/25	6:00 p.m.	Acid	Acid	0	...	...	...
10/15/25	427	57.7	7.30	9.7	1.0	370	...	....	20.2	85	45.8	10/15/25	6:30 p.m.	Alk.	N	0	...	350	...
10/16/25	445	52.8	....	9.7	1.4	292	...	....	35.6	...	....	10/16/25	6:30 a.m.	Alk.	Alk.	0	...	350	...
												10/16/25	6:30 p.m.	Acid	Acid	0	...	...	...
												10/17/25	6:30 a.m.	Alk.	Alk.	0	...	...	...
												10/17/25	6:30 p.m.	Alk.	Alk.	0	...	...	...
												10/18/25	6:30 a.m.	Alk.	Alk.	0	...	...	...
												10/18/25	6:30 p.m.	Alk.	Alk.	0	...	...	...
												10/19/25	6:30 a.m.	Alk.	Alk.	0	...	...	...
10/20/25	515	60.0	7.55	9.4	1.3	308	...	....	25.6	96	40.8	10/20/25	6:30 a.m.	Alk.	Alk.	0	...	...	...
												10/20/25	6:30 p.m.	Alk.	Alk.	0	...	...	...
									....	...	....	10/21/25	6:30 p.m.	Alk.	Alk.	F.t.	...	...	...
10/23/25	515	54.8	7.40	8.8	1.2	298	...	....	29.0	56	36.5	10/23/25	.....	Acid	Acid	+	...	300	...
11/ 6/25	532	61.5	....	...	...	...	...	5.68	....	...	32.5	11/ 6/25	.....	Alk.	Alk.	++	...	600	...

* All sodium determinations in this case were made on lithium citrated plasma.

acid reaction. On the seventh day of her illness, the infant had a severe generalized convulsion and was brought to the hospital for treatment. The blood and urine chemistry on admission and after the administration of sodium bicarbonate intravenously and sodium chloride subcutaneously and by mouth is shown in table 5. After the administration of the sodium bicarbonate there was shallow, depressed breathing and muscular rigidity and marked carpal spasm. The temperature and pyuria persisted for ten days, after which the infant seemed quite well.

COMMENT

It will be noted from table 1, and charts 1, 2 and 3, that in the cases of pyloric or high intestinal obstruction, the most constant blood changes are the low plasma chloride and the high plasma carbon dioxide con-

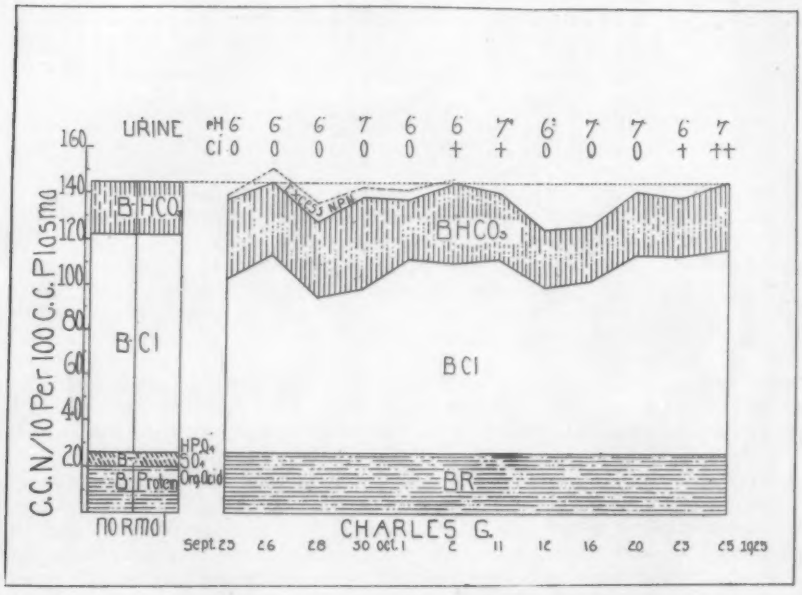

Chart 6.—Fistula of small intestine.

tents. Occasionally, the exact reaction (p_H) of the blood may be normal, but usually it is slightly more alkaline than normal, and in some instances markedly so. In the relatively few determinations made, calcium and magnesium and inorganic phosphate are found to be approximately normal. The total base bound by chloride and bicarbonate tends to be somewhat lower than normal. The total sodium, when determined directly, is also usually low. The nonprotein nitrogen is usually elevated; sometimes to a great extent. The variations in blood sugar are inconstant and seldom large. The plasma protein values vary inconstantly. In the few determinations made, lactic acid is found to be approximately normal.

TABLE 5.—*Patient with Pyelitis Receiving Sodium Bicarbonate Intravenously and Later, Sodium Chloride Subcutaneously and by Mouth.*

		Plasma								Whole Blood		Urine				Therapy—Remarks				
	Date	Sodium Chloride, Mg.	Carbon Dioxide, per Cent by Volume	p_H	Calcium, Mg.	Magnesium, Mg.	Sodium, Mg.	Phosphate, Mg.	Protein, per Cent	Non-protein Nitrogen, Mg.	Glucose, Mg.	Time	p_H	as Sodium Chloride, Mg. per 100 Cc.	Ammonia	$NaHCO_3$ Intravenously Gm.	0.85% Sodium Chloride, Cc.	Sodium Chloride by Mouth, Gm.	Depression Respiration	Tetany
					(serum)															
6/12/25	11:30 a.m.	515	55.7	7.47	8.5	...	288	2.4	5.03	24.0	142	11:30 a.m.*	6.20	41	++	...	...	...	..	..
					(serum)							2:55 p.m.	....	...	..	8.0	...	...	..	..
	4:10 p.m.	492	96.5	7.58	10.4	...	322	3.4	5.25	22.6	133	4:10 p.m.*	7.75	53	0	...	500	...	++	++
												7:30 p.m.	7.28	256	V.F.t.	...	...	1.0	..	..
												11:30 p.m.	7.28	304	V.F.t.	...	...	1.0	..	..
6/13/25	.....	...	....	....	....	...	...	...	....	....	...	1:00 a.m.	7.18	334	V.F.t.	...	...	...	..	..
												4:00 a.m.	7.26	422	V.F.t.	...	...	1.0	..	..
												6:00 a.m.	7.07	345	V.F.t.	...	...	1.0	..	..
												6:45 a.m.	7.38	450	V.F.t.	...	...	...	..	..
	10:40 a.m.	573	72.0	7.50	11.2	2.6	...	2.2	5.47	28.4	145	10:40 a.m.*	6.85	345	V.F.t.	...	...	1.0	+	+
6/30/25	11:50 a.m.	538	52.3	7.30	....	2.7	272*	6.9	....	33.6	102									

The urine specimens starred were obtained by catheterization under oil. The others were collected in test tubes and then covered with oil. All gave a negative $FeCl_3$ reaction for diacetic acid. The plasma sodium determination starred was made on lithium citrated plasma, the others on oxalated plasma.

The urine of this group of cases may be found acid, neutral or alkaline to litmus. Characteristically, however, it is free from, or contains but the faintest trace, of chloride. Ammonia is found to vary directly as the acidity, sometimes being present in large amount, at other times being absent. In no case was there sufficient diacetic acid to give a

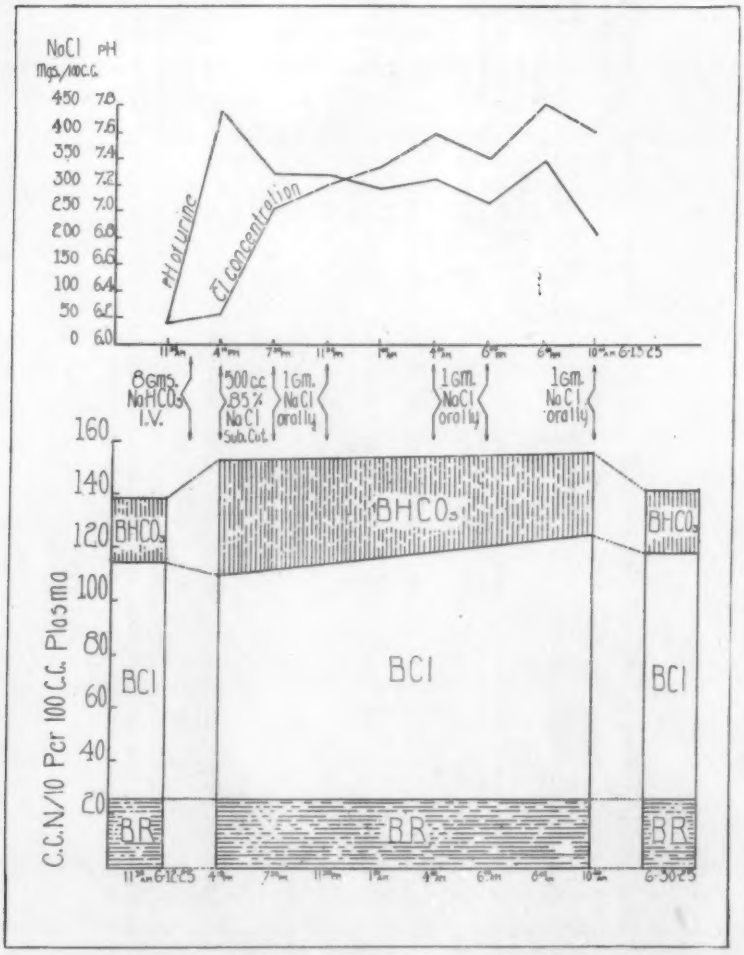

Chart 7.—Patient with pyelitis receiving sodium bicarbonate intravenously and sodium chloride subcutaneously and by mouth.

positive ferric chloride reaction, and because of this uniformity individual observations were not included in the tables.

From the protocols it will be noted that one of the most constant clinical findings is the altered type of breathing. When the patient is quiet, particularly after a crying spell, the respirations are shallow, slow and irregular because of apneic pauses which sometimes are quite

long. In addition to this change in breathing, general muscular hypertonicity and convulsions are not infrequently observed. In no case, however, was there a definitely positive Chvostek or Trousseau sign. Frequently fever is encountered without other clinical evidence of infection or leukocytosis.

In the second group of subjects (table 2, chart 4), in whom there existed obstruction low in the small intestine, somewhat similar chemical changes and clinical findings are encountered. In these cases, however, the tendency is for the carbon dioxide content to be less elevated, and the chloride content to be less reduced, while the nonprotein nitrogen tends to be higher.

It will be noted that in three infants (table 3, charts 3 and 5), clinical findings and chemical changes practically identical with those found in groups 1 and 2 are seen, despite the fact that there was no pyloric or intestinal obstruction. Vomiting, however, in all of these cases was severe.

Similar chemical changes, without, however, any marked similar clinical findings are noted in the case of intestinal fistula (table 4, chart 6). In this case vomiting did not occur, and obstruction proximal to the fistula was never very complete and was always transient.

In chart 8 are included McVicar's data on twenty-four adults with pyloric or high intestinal obstruction. The similarity with our data is apparent.

At first sight these changes may seem variable and without relation to one another or to any common cause. From closer study of the results, however, definite relations are apparent. In the first place, it can be noted that the chloride and carbon dioxide contents of the plasma bear an inverse relation to each other. Initially when the chloride is very low, the carbon dioxide content tends to be very high (table 1, cases 3, 6, 8, 9; table 3, case 16). During recovery, as the chloride rises toward the normal value, the carbon dioxide content falls toward the normal. Initially in such cases it may be noted that the reaction of the blood plasma may be only slightly more alkaline than normal, and even occasionally quite normal despite the presence of two or more times the normal sodium bicarbonate content. This fact is easily understood when we consider that the type of breathing encountered is just such as will favor the retention of free carbonic acid in the blood, and permit a normal ratio between the free carbonic acid and the sodium bicarbonate. That sometimes a high p_H or increased alkalinity should be found is also to be expected when we consider how easily hyperventilation may be induced, particularly by fever, administration of stimulants such as caffeine, examination, taking of blood samples or similar exciting causes. At such times the ratio $\frac{H_2CO_3}{NaHC_3}$ becomes less than normal, due to the blowing off of carbon dioxide, and the reaction

shifts in the alkaline direction. Clinically, at least, it appears that it is during these periods of uncompensated alkalosis that such symptoms of tetany as hypertonicity and convulsions are to be noted.

Depressed respiration, however, is not the only compensating factor in preventing actual increase in the alkalinity of the blood. Theoretically, perhaps, there might be expected to occur increased formation and retention of acid particularly organic, as well as excretion of base. That the former occurs in any but the markedly anhydremic cases, in which lactic acid may accumulate particularly, is very doubtful. The ketone acids, in our series at least, play no part, and would be expected to play none, provided carbohydrate metabolism were sufficiently high

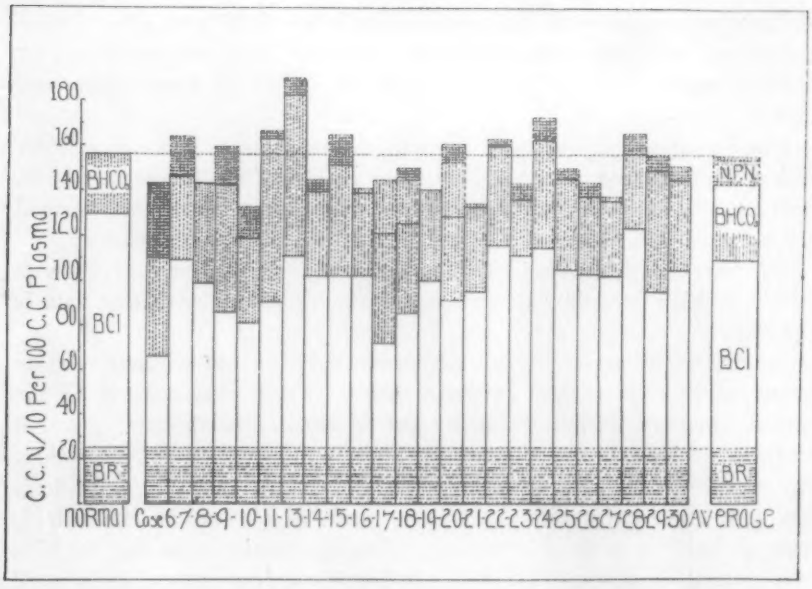

Chart 8.—McVicar's adult cases of pyloric and high intestinal obstruction.

to prevent ketosis. Excretion of base, however, sometimes occurs, as shown by the occasional very alkaline urine.

It is to be noted, however, that often sodium bicarbonate is not excreted in the urine in amount sufficient to render the urine alkaline, even though existing in much more than the normal amount in the blood (table 1, cases 6, 8 and 10; table 3, case 16 before therapy). This retention of base bicarbonate occurs when its increase has not equalled the reduction of plasma chloride. This condition is usually noted when the patient is first seen, before physiologic sodium chloride or Ringer's solution has been administered. After the administration of sufficient chloride, the urine becomes alkaline. It appears, therefore, that an equilibrium exists between base bicarbonate and base chloride, and that

the total salt or electrolyte concentration of the blood is kept normal or nearly normal, regardless of the individual concentration of base bicarbonate, or base chloride.

In some of the cases, however, particularly in the more severe cases of pyloric stenosis and the cases of obstruction lower in the small intestine, the sum of the base chloride plus base bicarbonate is considerable less than normal. The cause is probably similar to that found by Gamble and Ross,[29] who noted the same fact in their experimental work with rabbits; that is, base chloride (particularly sodium chloride) is secreted into the stomach and lost to the body, whether vomited or retained in the dilated stomach. Our data, however, indicate, but by no means prove, the possibility that during the periods of uncompensated alkalosis, base bicarbonate may be excreted in the urine, despite an already low total salt concentration of the blood plasma. It is of considerably more interest to note, however, that in these cases with low electrolyte content, the highest values for nonprotein nitrogen are usually found.

In an effort to determine whether nonprotein nitrogen makes up particularly from an osmotic pressure standpoint, the deficiency of total electrolyte caused by the failure of the increased base bicarbonate to balance the loss of base chloride, the osmotic equivalent of the excess nonprotein nitrogen in terms of tenth normal electrolyte was roughly calculated. For this purpose, for want of more definite information, it was assumed that the increase of nonprotein nitrogen was entirely urea nitrogen, and therefore a nonelectrolyte with one-half the osmotic pressure of the molecular equivalent of fully dissociated salts such as sodium chloride and sodium bicarbonate. For example, the cubic centimeters of tenth normal electrolyte equivalent to an excess of 100 mg. of urea nitrogen per hundred cubic centimeters of blood are calculated as follows:

$$\text{Mgs. urea N excess} \times \frac{\text{Mol. wt. urea}}{\text{Atomic wt. N} \times 2} = \text{mgs. urea excess}$$

$$\frac{\text{Mgs. urea excess}}{\text{Wt. urea per 100 cc. for N/10 Sol.}} \times 100 \times \tfrac{1}{2} = \text{cc. N/10 equi. electrolyte per 100 cc. blood}$$

$$\text{or } 100 \times \frac{60}{28} \times 1 \times \frac{100}{600} \times \tfrac{1}{2} = \frac{1000}{56} = 17.8 \text{ cc.}$$

Charts similar to those made by Gamble [29] were then constructed so as to show the total amount of tenth normal electrolyte present in the blood plus that equivalent to the increase in nonprotein nitrogen. Our own normal values for the chloride and carbon dioxide contents found in infants were used. They are somewhat lower than the normal adult figures. The same figure (26 cc. tenth normal solution per hundred cubic centimeters plasma) used by Gamble for the amount of base bound by protein, phosphoric, sulphuric and organic acids was adopted in completing the charts. This value was assumed to be constant.

29. Gamble, D. L., and Ross, S. G.: J. Clin. Investigation **1**:403, 1925.

From a study of these charts, the relationships before mentioned are perhaps better seen. Charts of data obtained before sodium chloride solution was given show a total salt concentration less than the normal (146 cc. tenth normal per hundred cubic centimeters). This deficiency is made up sometimes wholly, sometimes only in part, by the retention of nonprotein nitrogen. Sometimes the balance is almost exact (Baby G., chart 1; Baby M., chart 2; Lilly H., chart 4; chart 8, average of twenty-four adult cases). After saline solution has been given or after loss of gastric content from vomiting or drainage through an intestinal fistula ceases (Raymond R., chart 1; Virginia E., chart 2; James C., chart 3; Patricia B., chart 5; Charles G., chart 6), chloride increases in the blood and bicarbonate decreases. When the total amount of electrolyte present plus the equivalent of the retained nonprotein nitrogen exceeds the normal, bicarbonate is excreted in high concentration, sufficient to make the urine very alkaline and chloride appears for the first time in the urine (Raymond R., chart 1, Virginia E., chart 2; Patricia B., chart 5; Charles G., chart 6). At such a time also the blood nonprotein nitrogen falls to a normal or near normal value.

Since some of the charts do not show close balancing because apparently not enough nonprotein nitrogen was retained (Lynn B., chart 1; Virginia E., chart 2; Joe W., chart 4), it might be argued that our interpretation of the rise in nonprotein nitrogen is probably incorrect. It is possible, however, that in these cases considerably more base than that assumed might have been bound by protein and organic acid, since these cases appeared clinically the most desiccated. Furthermore, no allowance was made for the effect of increased free carbonic acid. It is possible, therefore, that a more exact balance might actually have existed.

That nephritis in the strict sense of the word accounts for the retention of nonprotein nitrogen is much to be doubted, since recovery is so speedy. Just what part anhydremia plays in causing temporary functional retention is difficult to evaluate. Certainly, some very anhydremic cases show little retention of nonprotein nitrogen. When we consider that the urine in the cases with low plasma electrolyte is practically free from salt, we would expect a greater rather than a lessened ability of the urine to carry out urea. Further work to help clarify this point is in progress.

From table 5 and chart 7, it can be noted that, following the administration of sodium bicarbonate intravenously in a case of pyelitis, both sodium bicarbonate and sodium chloride were excreted in the urine, despite the fact that the plasma chloride content was already low. Here again it is chiefly the total salt content which seems to determine the excretion of different salts, regardless of their individual concen-

tration. Following the administration of sodium chloride subcutaneously and by mouth, sodium bicarbonate continued to be excreted in the urine; apparently because the administration of the chloride maintained a total electrolyte concentration above the normal value.

CONCLUSIONS

From these results, we feel that the changes in the chemical composition of the blood seen in cases of pyloric and intestinal obstruction in infants and children can be explained entirely by loss from the body of gastric and intestinal secretions. We feel that Haden and Orr are not justified in their assumption that chloride migrates from the blood into tissues to detoxify a hypothetic toxic substance. We see no reason why simple hypertrophic pyloric stenosis should give rise to toxin formation and absorption as in the case of the strangulated intestinal obstruction. If toxin were actually present and reacted molecularly with hydrochloric acid, the amount of toxin formed would have to be very large and its potency therefore must be much less than that of the proteose recovered from the intestinal loops. No such substance has been found by Haden and Orr in the blood or urine of their animals with pyloric obstruction.

We wish further to emphasize the point brought out by Copher and Brooks,[30] that toxicity and death may follow intestinal obstruction in dogs when the blood chloride is only little changed. The improvement noted by practically all observers following chloride administration in these cases results only from its effect in restoring to normal the altered chemical composition of the blood, which lessens the danger of uncompensated alkalosis and tetany and restores electrolyte which enables the body to hold its normal water content.

In a paper shortly to follow, the reciprocal relationships between chloride, bicarbonate and nonprotein nitrogen will be discussed in several different types of cases, when the concentration of one or more of these substances in the blood is markedly abnormal.

SUMMARY

The significance of the chemical changes in the blood and urine encountered in cases of pyloric and intestinal obstruction in infants and children can be summarized as follows:

1. As a result of vomiting, chloride is lost.

2. As chloride diminishes in the blood, bicarbonate is retained and compensates at least in part for the deficiency in electrolyte, so that the total salt concentration still remains nearly normal.

30. Copher, G. H., and Brooks, B.: Ann. Surg. **78**:755, 1923.

3. When the loss of sodium chloride in the blood is not fully replaced by sodium bicarbonate, the nonprotein nitrogen becomes elevated, to the extent of keeping (theorectically) osmotic pressure normal.

4. When the sodium bicarbonate content of the blood is high, there is a depression of respiration sufficient to lead to the accumulation of enough carbonic acid to maintain an approximately normal $\frac{H_2CO_3}{NaHCO_3}$ ratio, so that the reaction of the blood (p_H) is usually nearly normal. Following increased pulmonary ventilation from any cause, however, the blood becomes abnormally alkaline and manifestations of tetany may appear.

5. When the deficiency of sodium chloride in the blood disappears as a result of the administration of sodium chloride, the excess of nonprotein nitrogen and sodium bicarbonate in the blood is rapidly excreted by way of the urine.

6. Excretion of sodium bicarbonate, sodium chloride and nonprotein nitrogen depends on the total concentration of crystalloid (electrolyte and nonelectrolyte) in the blood. When this concentration is less than normal, sodium bicarbonate is retained in the blood, and the urine remains acid in reaction despite the presence of a greatly increased plasma carbon dioxide content.

7. Marked vomiting without actual organic pyloric or intestinal obstruction may also lead to identical chemical changes.

8. Loss of gastric or intestinal secretion by way of fistulas results in the same chemical changes as does vomiting.

THE METABOLISM OF SALTS IN NEPHRITIS

I. CALCIUM AND PHOSPHORUS *

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During recent years, an increasingly important place has been accorded the study of the inorganic elements of the blood in nephritis. Numerous reports of the concentration of the various salts of the blood have appeared. Few, if any, of these include any investigation of the total salt metabolism, and conclusions as to retention, or depletion, of one or the other salt in the body are based solely on its concentration in the blood. It was, therefore, thought to be a matter of considerable interest to determine the total metabolism of the salts in nephritis and its relationship to their concentration in the blood. For the past two years, suitable cases in the Hospital for Sick Children have been investigated in this manner. The number of cases studied has been limited by restrictions such as are imposed when accurate measurements of intake and excretion are essential. Thus, all cases in which vomiting was persistent had to be excluded, as well as those in which accurate collection of excreta was difficult because of the age or sex of the patients. Such restrictions being unessential in the study of the chemistry of the blood, more cases were available for this purpose.

Calcium, potassium, sodium, magnesium, phosphates, sulphates and chlorides all received consideration. It was deemed advisable for the sake of clarity, to report the results of this investigation in a series of papers dealing with two or three of the salts in each, and concluding with one in which the total base would be considered as such, and the results of the series summarized.

PLAN OF INVESTIGATION

All children who were to be studied were placed on an exclusive milk diet on admission to the hospital. Each child was allowed from 1,200 to 1,500 cc. of whole milk daily, depending on the age. No medication other than liquid petrolatum was administered during the preliminary or the metabolism period. After a minimum of three days on this diet, metabolism studies were commenced. The bowel and

* Received for publication, March 29, 1926.
* From the Wards of the Hospital for Sick Children, and the Nutritional Laboratories of the Sub-Department of Pediatrics, University of Toronto.

bladder were emptied immediately preceding the metabolism period, and this material was discarded. All urine and feces were saved in twenty-four hour lots for three, or preferably four, days. Simple enemas were used when necessary. By venipuncture, a sample of blood was obtained for analysis, during the middle of this period. When blood analyses only were possible, specimens were obtained during fasting. Exclusive milk diets were used in all but one of the cases in which total balances were studied. This patient was unable to retain the milk, and we were forced to use cereal gruels made with milk. A composite sample of the milk used by each child was analyzed.

Method Used.—The analyses of food and excreta were made by the standard gravimetric methods as outlined by McCrudden.[1] Blood phosphates and calcium were determined by Kramer and Tisdall's methods.[2]

BLOOD STUDIES

In 1915, Greenwald[3] first demonstrated an increase in the acid soluble phosphorus in the blood of nephritic patients due to defective excretion. Added importance was attached to plasma phosphate retention the following year, when Marriott and Howland[4] reported further investigations, as a result of which they concluded that phosphate retention was the cause of nephritic acidosis. Fetler[5] has recently confirmed their findings. Phosphatemia, not associated with specific symptoms of renal disease, has been reported by Denis and Hobson[6] and by De Wesselow.[7] Some of these observers have also noted decreases in the calcium content of the plasma, which were regarded by them as secondary to the phosphate increases.

In table 1 are given the results of thirty-six plasma phosphate and twenty plasma calcium determinations in nearly that many of our cases of nephritis. The diagnoses given are probably as accurate as clinical diagnoses of renal lesions are usually proved to be. All types of nephritis, including two of the arteriosclerotic type so rarely seen in childhood, are included in the study. These cases marked "X" were not necessarily on exclusive milk diets, and complete metabolism studies were not possible. In these cases, the blood was obtained by veni-

1. McCrudden, F. H.: Am. J. Physiol. **14**:389, 1905; ibid. **17**:211, 1906-1907.
2. Kramer, B., and Tisdall, F. F.: J. Biol. Chem. **50**:329, 1922; ibid. **47**:475, 1921.
3. Greenwald: J. Biol. Chem. **21**:29, 1925.
4. Marriott, H. McK., and Howland, J.: Phosphate Retention as a Factor in the Production of Acidosis in Nephritis, Arch. Int. Med. **18**:708 (Nov.) 1916.
5. Fetler, W. J.: Phosphates in Nephritis, Arch. Int. Med. **31**:413 (March) 1923.
6. Denis, W., and Hobson: J. Biol. Chem. **55**:183, 1923.
7. De Wesselow, A. L. W.: Quart. J. Med. **16**:341, 1922-1923.

puncture during fasting. The results are expressed in milligrams per hundred cubic centimeters of plasma and also in cubic centimeters of tenth normal per hundred cubic centimeters of plasma.

An increase of plasma phosphate to more than 5 mg. per hundred cubic centimeters of plasma, which is considered by De Wesselow as the maximum normal value, and is somewhat higher than the normal range

TABLE 1.—*Phosphate and Calcium of the Blood Plasma*

		Phosphate		Calcium				
Case	Age	Mg. per 100 cc.	Normal 10th per 100 cc.	Mg. per 100 cc.	Normal 10th per 100 cc.	Edema	Acidosis	Diagnosis
1	13	5.0	3.0	8.0	4.0	0	0	Acute glomerular nephritis
2	10	5.8	3.5	8.0	4.0	0	0	Acute glomerular nephritis
3	10	3.0	1.8	8.9	4.9	0	0	Acute glomerular nephritis
4	11	7.1	4.2	8.8	4.7	0	++	Acute glomerular nephritis
5	11	7.0	4.2	9.1	4.5	0	++	Acute glomerular nephritis
6	13	3.8	2.3	8.1	4.75	0	0	Acute glomerular nephritis
x7	7	5.8	3.4	8.0	4.0	0	0	Acute glomerular nephritis
x8	9	5.7	3.4	8.3	4.1	0	0	Acute glomerular nephritis
9	8	5.0	3.1	9.3	4.6	0	0	Acute glomerular nephritis
10	9	7.5	4.5	8.6	4.3	0	+	Acute glomerular nephritis
x11	6	4.8	2.8	...	...	0	0	Acute glomerular nephritis
x12	6	5.21	3.0	...	...	0	0	Acute glomerular nephritis
x13	6	4.61	2.7	...	...	0	0	Acute glomerular nephritis
x14	6	5.6	3.3	...	...	+++	0	Acute mixed nephritis
x15	6	6.4	3.8	...	...	0	0	Acute mixed nephritis
16	4	5.0	3.0	9.5	4.7	++	+	Acute mixed nephritis
17	3	5.0	3.0	10.0	5.0	++	0	Acute mixed nephritis
x18	6	6.0	3.5	...	...	+++	0	Acute mixed nephritis
x19	2½	5.0	3.0	7.5	3.8	+++	0	Chronic tubular nephritis
x20	9	5.1	3.0	...	...	++	0	Chronic mixed nephritis
x21	9	5.88	3.4	...	...	0	0	Chronic mixed nephritis
22	6	6.5	3.9	9.0	4.5	++	+	Chronic interstitial nephritis
x23	11	5.7	3.4	...	...	0	0	Chronic nephritis with arteriosclerosis
x24	11	7.5	4.4	...	...	+	0	Chronic nephritis with arteriosclerosis
	9	7.05	4.3	...	...	0	0	Chronic nephritis with arteriosclerosis
	9	7.06	4.0	...	...	0	0	Chronic nephritis with arteriosclerosis
25	8	6.3	3.8	7.2	3.6	++++	+	Chronic nephrosis (Epstein type)
	9	6.0	3.6	8.3	4.6	+	0	Chronic nephrosis (Epstein type)
x26	3	7.0	4.2	8.5	4.2	++++	+	Chronic nephrosis (Epstein type)
x27	2	5.0	3.0	8.0	4.0	+++	+	Chronic nephrosis (Epstein type)
x28	12	10.9	6.5	7.4	4.4	+++	+	Chronic mixed nephritis
29	8	8.0	4.8	8.5	4.7	++	++	Cardiorenal
x30	10	4.4	2.6	...	...	0	0	Kidney infarct
x31	12	10.0	5.9	...	...	0	++	Uremia, renal calculus
x32	12	7.5	4.5	8.0	4.0	++	+	Chronic mixed nephritis
x33	2	6.0	3.6	...	...	+	0	Chronic mixed nephritis

Values are given in (1) mg. per hundred cubic centimeters of plasma. Normal values are phosphates 1.9 to 3.8 (or possibly 5), calcium 9 to 11. (2) Terms of normal per hundred cubic centimeters of plasma. Normal values are hydrogen phosphate, 3.0; calcium, 5.0.

usually given, was noted in twenty-four instances, or 66 per cent of the determinations. This is somewhat higher than the percentage found by Denis, who found increased phosphates in only 45 per cent of ten cases studied. Possibly on this account a larger proportion of our cases, 71 per cent, had low blood calcium, as opposed to 22 per cent of Denis' cases.

A reciprocal relationship between the phosphates and calcium of the blood has been noted by certain observers. Marriott attributed the low calcium found in some nephritic cases to phosphate retention. De Wesselow observed the complementary nature of these salts in the blood. Chart 1, in which the calcium and phosphate values which were obtained are plotted against each other, shows this reciprocal relationship to hold roughly. In all cases with phosphate retention, the inverse ratio holds good, but as the phosphate values approach normal, calcium tends to be in a less constant relationship to it.

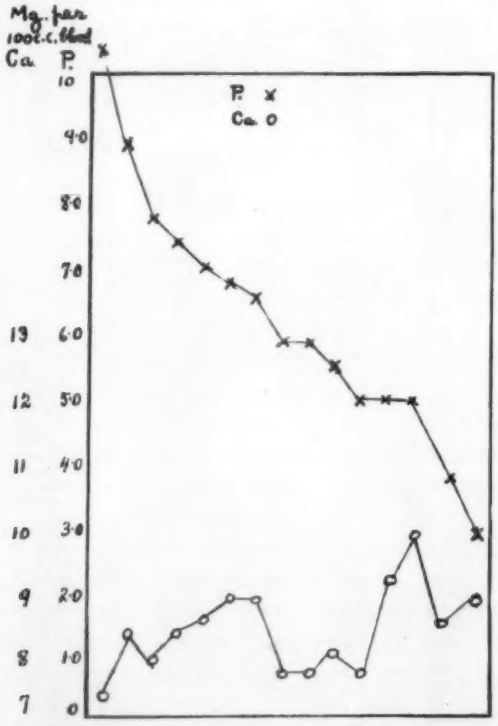

Chart 1.—Relation between calcium and phosphates of blood.

All cases of acidosis were accompanied by phosphatemia, as pointed out by Marriott, and by Denis and Minot.[8] A consideration of the rather insignificant changes in the phosphate of the plasma in terms of tenth normal produced by an increase of 200 per cent in the phosphate concentration being only a change of approximately 4 per cent of the total fixed base of the plasma, makes one hesitate to regard it as responsible for nephritic acidosis. That the phosphate ion is of itself

8. Denis, W., and Minot, A. S.: A Study of Phosphate Retention from the Standpoint of Blood Analysis, Arch. Int. Med. **26**:99 (July) 1920.

toxic has been demonstrated by Greenwald [8] and by Tisdall.[9] It is quite plausible to assume, therefore, that its association with acidosis in nephritis is a coincidence, or that some of the symptoms of the latter are the result of its toxicity rather than a disturbance of acid-base equilibrium. Further, the lack of agreement between clinical evidence of acidosis and the height of the blood phosphates would indicate that their retention is not necessarily accompanied by acidosis.

The level of the blood phosphates or calcium is apparently very little influenced by the presence of edema per se. It is true that in many of the cases with water retention, high phosphates and low calcium values were obtained, but this would appear to be due to other factors than the edema itself, as, for example, the more serious type of kidney lesion usually found in all hydremic subjects in childhood, or to blood dilution. It had been anticipated that high blood phosphates or low calcium might play a rôle in excessive fluid retention because of the beneficial results we have obtained [10] in these subjects by the administration of calcium salts. The possibility that phosphate retention does occur elsewhere than in the blood must be borne in mind; as will be pointed out later, general metabolism studies would indicate this as a probable explanation.

In acute nephritis, unless associated with acidosis, only a mild increase of phosphate in the blood, if any, is observed. Such moderate increases are rarely persistent, and, as De Wesselow pointed out, are not inconsistent with complete recovery. Phosphate retention is consistently present in acute or chronic acidosis. Slight diminution in the serum calcium is a frequent but not constant finding. In chronic nephritides, phosphates are more consistently and strikingly increased in the azotemic type, while the diminution of blood calcium is more noticeable in the hydremic type. That the blood calcium, about a third of which is usually in colloidal form, would be decreased in cases of chronic tubular nephritis of which hydremic nephritic largely consists, is to be expected when one considers the degree of blood dilution usually present. In our cases of this type, the plasma proteins averaged a little over 5 per cent, and were never over 6 per cent. The cell volume was usually from 25 to 30 per cent, and while edema was present, never exceeded 35 per cent. It is quite likely the absence of more than moderate increase in blood phosphates might be attributed to the same cause rather than to any selective action of the kidney displayed in their excretion. The greatest and most persistent increase in blood phosphates is found in cases of chronic azotemic nephritis, and in those cases consistently low calcium values are found.

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9. Tisdall, F. F.: J. Biol. Chem. **54**:35, 1922.
10. Boyd, G. L.: Nephritis in Children, Am. J. Dis. Child. **23**:375 (May) 1922.

The blood phosphates give valuable aid in making the prognosis in nephritis. Transitory increases due to acidosis being excluded, a rise in the blood to 7 mg. per hundred cubic centimeters indicates the presence of severe permanent damage or a progressive lesion, inconsistent with anything like complete recovery. In our series, none of these patients has attained to anything better than semi-invalidism in the two years that have elapsed since the observation was made. From De Wesselow's figures and our own, values of 10 or more indicate impending death.

Phosphatemia in renal disease might be attributed to either a disturbed acid-base balance in the body, or to a functional impairment of the kidney to excrete these salts. As pointed out before, the first of

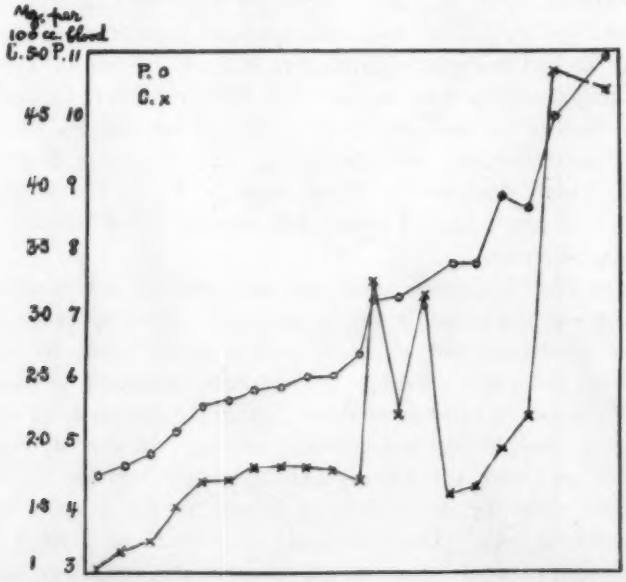

Chart 2.—Relation between phosphates and creatinine of blood.

these is unlikely because of the relatively insignificant change in the total acid increases in phosphate retention produced. That the kidney exerts a selective activity in relation to the products it excretes has been frequently demonstrated. Mayrs [11] showed the concentrating power of the kidney for creatinine and phosphates to be approximately the same. De Wesselow, in commenting on the grave prognostic import of high plasma phosphates, regarded it of the same significance as high blood creatinine. In chart 2 are plotted the phosphate and creatinine content to twenty of our cases. A rough parallelism is noted between them. Discrepancies occur in acute acidotic cases, in which no significant changes in the creatinine content are found.

11. Mayrs: J. Physiol. **56**:58, 1922.

TABLE 2.—*Salt Metabolism in Nephritis* *

Case	Age	Phosphorus Pentoxide						Calcium Monoxide					
		Intake	Feces	Absorbed	Urine	Balance	Blood	Intake	Feces	Absorbed	Urine	Balance	Blood
1	13	2.8778	1.2619	1.6159	1.6452	—.0293	5.0	1.9916	1.3756	.6160	.0343	+.5817	8.0
2	10	3.1643	1.9741	1.1902	1.5346	—.3444	5.8	2.2446	2.2102	.0344	.0331	+.0013	8.0
3	9	2.8750	2.1804	.6946	.8566	—.1620	3.0	2.0326	2.1357	—.0989	.0401	—.1390	8.9
4	13	2.3469	1.5717	.7752	1.8721	—1.0969	3.8	1.6621	1.9226	—.2605	.0376	—.2981	8.5
5	11	5.0565	2.9732	2.0833	.3889	+1.694	7.0	2.9164	2.5658	.3506	.0504	+.3002	9.1
6	8	4.3035	1.9504	2.3531	1.3333	+1.0198	5.5	2.2995	2.1589	.1406	.0330	+.1076	9.3
7	9	4.5904	1.2276	3.3628	1.6231	+1.7379	7.5	2.4528	1.5523	.9005	.0366	+.8639	8.6
8	10	1.2811	2.0437	—.7626	.4102	—1.1728	7.1	.5636	1.4179	—.8549	.0346	—.8889	8.8
9	4	3.4611	1.1881	2.2735	.7725	+1.5010	5.0	1.9965	1.2896	.7069	.0373	+.6696	9.5
10	3	2.3400	.....	.....	.9400	.....	5.0	.....	.....	.....	.0370	.....	10.0
11	8	3.0271	1.7168	1.3013	1.1118	+.1985	8.0	2.1435	2.0286	.1149	.0380	+.0774	8.5
12	6	6.7060	2.1694	4.5366	.9148	+3.6218	6.5	3.8677	2.3228	1.5449	.0444	+1.5005	9.0
					+Feces	.....					+Feces		
13	8	2.5842	.....	.....	2.7249	—.1407	6.3	1.7884	.....	.....	1.6269	+.1615	7.2
	9	3.8309	1.3116	2.5193	1.1696	+1.3497	6.0	2.2095	1.6150	.5945	—.0427	+.5518	8.3

* Phosphates are given as phosphorus pentoxide; calcium as carbon monoxide. The values indicated are in grams. The cases tabulated below the single line are those having edema. The amount absorbed is obtained by deducting the number of grams excreted in the feces from the intake.

TABLE 3.—*Salt Metabolism in Normal Children* *

Case	Age		Phosphorus Pentoxide				Calcium Monoxide				
			Intake	Feces	Absorbed	Urine	Balance	Intake	Feces	Absorbed	Urine	Balance
1	3	7/12	2.394	.843	1.551	1.243	+.309	1.239	.954	.285	.025	+.259
2	3	8/12	2.311	.774	1.537	1.168	+.369	1.224	.986	.238	.032	+.206
3	4	7/12	2.458	1.012	1.446	1.085	+.360	1.246	.972	.274	.017	+.256
4	6	.....	2.829	1.031	1.798	1.552	+.254	1.290	.850	.440	.160	+.290
5	6	.....	1.947	.465	1.482	1.239	+.243	1.038	.668	.370	.048	+.322
6	7	4/12	2.244	.730	1.514	1.212	+.302	1.252	.768	.484	.080	+.405
7	8	9/12	1.828	.474	1.354	1.141	+.213	.916	.482	.434	.029	+.406
8	9	6/12	2.355	.864	1.491	1.037	+.454	1.252	.812	.440	.059	+.382
9	10	11/12	3.170	.960	2.210	1.511	+.698	1.378	.852	.526	.104	+.423
10	11	5/12	3.000	.994	2.006	1.349	+.657	1.348	.869	.479	.046	+.434
11	11	7/12	2.968	.768	1.200	1.397	+.802	1.350	.700	.650	.059	+.592
12	13	6/12	3.343	.577	2.766	1.559	+1.207	1.424	.452	.972	.101	+.871

* The amount absorbed is obtained by deducting the fecal output from the intake.

METABOLISM STUDIES

The results obtained in the study of the complete metabolism of calcium and phosphorus in the fourteen nephritic patients so studied are given in table 2. For purposes of comparison, the results obtained by Sherman and Hawley [12] in similar studies on normal children are given in table 3. The same methods were used by these investigators.

There was a positive calcium balance in all but three of the nephritis cases. In these, the negative balance was apparently due to their low intake rather than any differences in their renal lesion. A negative balance was obtained in none of the normal subjects studied by Sherman and Hawley. In some unpublished studies by one of us (A. M. C.), it was found to obtain in normal subjects only when the daily intake was less then 0.5 Gm., a minimum intake lower than that of any of the nephritic patients. A greater tendency to excretion of more calcium than ingested is apparent in some of those suffering from renal lesions, but in the majority of subjects, comparable balances are obtained with similar intakes. Patients having a negative calcium balance all had slightly decreased blood calcium, but some of those with a positive balance had lower values. The absorption of calcium was much more variable in the nephritic patients than in the normal subjects, in whom it is singularly constant. No consistent abnormality in the absorption was present in the pathologic cases, and the fluctuations may quite possibly be due to such extraneous factors as the degree of constipation caused by milk diets.

The urinary output of calcium was lower in the pathologic than in the normal subjects. This applies to both the percentage of the intake excreted by the kidney and the actual concentration in the latter. As Sherman and Hawley do not give the volume of the urine excreted in their subjects, we have used unpublished figures obtained by one of us (A. M. C.) to obtain the normal calcium concentration in table 4. In view of Marriott's contention that low blood calcium is due to increased fecal excretion of calcium caused by high blood phosphates, it is interesting to note that those with the highest fecal calcium were those with increased blood phosphates and very frequently low blood calcium. No metabolic studies were made on patients receiving calcium salts for the edema present. Additional calcium in the diet was usually cared for by an increased excretion through the bowel, and occasionally by increased retention.

A unit volume of nephritic urine contained only a tenth to one-half the amount of calcium that the same volume of normal urine did. These figures are given in table 4, and are sufficiently striking to force one to the conclusion that in addition to the smaller absorption from the bowel,

12. Sherman, H. C., and Hawley, E.: J. Biol. Chem. **53**:375, 1922.

some impairment of the renal function for excretion of these salts is present, and helps to bring about lower retention. This functional incapacity was present in all types of nephritis, independent of the presence or absence of edema, or low blood calcium values. Further, it was independent of the intake as far as the latter varied on the milk diets. Hétényе and Nogradi [13] have recently demonstrated that delay occurs in the excretion of calcium salts when injected into nephropathic patients. These observers claim that this decrease in the rate of calcium excretion parallels the degree of retention of chlorides. We were unable to confirm this finding from our figures, which of course represented calcium taken per os and and not given parenterally.

TABLE 4.—*Relation of Calcium Intake to Phosphorus Excretion* *

		Calcium				Phosphates				
Case	Age	Intake	Amt. of Urine	Mg. per 100 cc.	Per Cent Intake in Urine	Intake	Mg. per 100 cc.	Per Cent Intake in Urine	Balance	Edema
1	6	2.24	655	37	11.6	2.87	162	38.0	+	..
2	6	1.62	445	13	4.3	2.42	159	29.4	+	..
3	5	2.20	486	21	4.75	3.32	217	31.7	+	..
4	9	2.31	715	23	7.4	3.42	132	37.8	+	..
5	6	.48	365	21	18.35	1.04	101	35.5	—	..
6	8	.63	545	15	12.8	1.46	169	62.8	—	..
7	13	1.99	1,371	2.5	1.7	2.88	119	57.2	—	0
8	10	.56	1,260	2.6	1.5	1.28	119	32.0	—	0
9	13	2.21	1,368	2.0	2.3	3.83	136	30.5	—	0
10	8	2.24	545	6.9	1.8	3.16	208	48.5	+	+
	9	3.87	850	5.0	1.9	6.71	136	13.5	+	0
11	9	2.03	793	5.0	2.0	2.88	108	29.8	—	0
12	10	1.66	446	7.6	6.1	2.35	90	79.8	—	0
13	11	2.92	1,158	4.6	1.7	5.06	32	7.7	+	0
14	6	2.00	945	4.6	1.2	3.46	96	22.3	+	+
15	4	2.14	710	5.0	1.9	3.06	108	36.7	+	+
16	3	....	772	4.8	...	....	...	....	..	+
17	..	2.45	1,829	1.9	1.5	4.59	89	35.4	+	0
18	..	2.30	1,270	2.6	1.4	4.30	105	31.0	+	0

* The figures above the single line represent normal values; those below, the figures obtained in nephritic cases.

A negative phosphate balance was present in all except three non-hydremic nephritic patients. In these, defective urinary secretion was present in addition to a greater intake. All patients except two (E. D. and G. B.) with edema had a positive phosphate balance. Both of these ingested very small amounts, and the first one later had a positive balance with a greater intake in her food. The evidence of actual phosphate retention furnished by balance studies does not always coincide with that given by the blood findings.

The daily excretion of phosphates in grams does not vary materially from that of healthy children. Comparison of the figures in table 4, showing the percentage of the intake excreted in the urine, in many instances shows higher values for the nephritic patients than for the normal subjects. The only exceptions were those with a larger intake

13. Hétényе, G., and Nogradi, S.: Klin. Wschnschr. **4**:1308, 1925.

and absorption, which apparently do not exert much influence on the amounts excreted in the urine. The phosphate concentration in the urine fluctuates widely in both health and disease, and that in the latter is for the most part within the normal range. Three patients showed a definite renal insufficiency in concentrating phosphates in the urine. All three had well marked cases of acidosis, with progressive kidney lesions of a severe type. In one, the intake was twice that in another, but the amount per unit volume of urine was only half, showing an independence of renal function and intake. The concentration of the urine phosphates bears a more consistent relation to that of the blood than does the retention demonstrated by the balance between the intake and output. Low urine concentration values are accompanied in every case by increase in the blood phosphate.

The influence of calcium intake on phosphorus excretion has been given considerable study. Telfer [14] and Kockman, Petah and Rudell,

TABLE 5.—*Relation of Calcium Intake to Phosphate Excretion*

	Intake			Excretion of Phosphate		
Case	Calcium Monoxide	Phosphorus Pentoxide	Feces	Percentage of Intake in Feces	Urine	Percentage of Intake in Urine
1	3.8677	6.7060	2.1694	32	.9148	14
2	2.9164	5.0565	2.9732	58	.3889	7.7
3	2.2446	3.1643	1.9741	62	1.5346	50
4[2]	2.2095	3.8309	1.3116	34	1.1696	30
5	2.1435	3.0271	1.7168	43	1.1118	36
6	2.0826	2.8750	2.1804	79	.8566	30
7	1.9965	3.4611	1.1188	34	.7725	22
8	1.9916	2.8778	1.9741	68	1.6452	58
9	1.6621	2.3469	1.5717	68	1.8721	80
10	.5636	1.2811	2.0437	159	.4102	32

quoted by him, all claim that the increases of calcium intake cause an increase in fecal phosphate and a decrease in urinary phosphate. Our observations are given in table 5. Changes in the calcium intake did not result in the expected changes in the percentage of the intake excreted by the feces. This may be due to the smaller absorption from the bowel in nephritic patients, and the slight impairment of the kidney's power to excrete phosphates shown to be present in most of them.

1. Blood phosphates were increased in 66 per cent of the nephritic serums examined. Blood calcium was decreased in 71 per cent of the series.

2. The calcium and phosphates of the blood in nephritis bear an approximately reciprocal relationship to each other.

3. High blood phosphates were usually found in patients with acidosis, but were also noted in some patients with no acidotic symptoms.

14. Telfer, S. V.: Quart. J. Med. **17**:45, 1922-1923.

4. Symptoms or signs of nephritis other than acidosis do not appear to bear any direct relationship to the level of the blood calcium or phosphate.

5. Serum phosphates are apparently of some prognostic value in nephritis, when transitory rises due to acidosis are excluded. A persistent moderate increase indicates the presence of a progressive renal lesion.

6. High blood phosphates have a prognostic value comparable to high blood creatinine except when acidosis is present.

7. Nephritic children have a positive calcium balance unless their intake falls to a low level, slightly higher than the minimal on which normal children have a positive balance. The difference is probably due to better absorption in normal children on more bulky diets.

8. The nephritic kidney is functionally incapable of excreting calcium in a normal manner. This is evidenced by the low total excretion of calcium, and more strikingly by its decreased concentration in the urine.

9. The calcium balance is apparently independent of the blood calcium content.

10. The presence or absence of edema plays an important part in the phosphate balance. Nonhydremic subjects have a negative balance in most cases, and extraneous factors explain the exceptions. Edematous subjects all had a positive phosphate balance, except two with a minimal intake.

11. The evidence of phosphate retention given by blood and balance studies does not always agree.

12. The daily excretion of phosphates in nephritic patients compares favorably with that of the normal. The percentage of the intake found in the urine in the pathologic subjects often exceeds that in the healthy subjects. The phosphate concentration of the urine is usually within normal range. In those in whom it was strikingly decreased, the blood phosphates were always high.

13. Variations in the calcium intake did not influence the proportion of phosphate excreted by urine or bowel.

PARANASAL SINUSITIS IN INFANTS AND IN YOUNG CHILDREN *

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A large part of the work of the pediatrician concerns infections, even in the field of infant nutrition. A large proportion of these infections consist of, or result from, upper respiratory inflammation. For many years the importance of diseased tonsils and adenoids has been realized, both in their direct and indirect effects. That paranasal sinus infection is of equal importance is realized only incompletely. This is due to the more recent recognition of the rôle of sinus disease, and to the fact that the knowledge of its importance has not been disseminated sufficiently.

That sinus disease occurs with considerable frequency in certain parts of this country has been shown by a number of observers.[1] The opinion is encountered that there is a tendency to overemphasize its importance in children, because it is a new idea and therefore a new panacea, and that it can only take its proper place after it has withstood the test of time. To some extent this may be true. It is also possible that this opinion arises chiefly in those sections in which sinus infection is uncommon for climatologic reasons. To one working in a region in which sinus disease is common, and in association with a rhinologist who recognizes sinusitis readily, it seems difficult to exaggerate its importance. Improvement following the treatment of sinusitis in many instances has been so definite and marked as to be convincing as to the rôle this infec-

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* From the Department of Pediatrics, College of Medicine, State University of Iowa.

* Read before the forty-seventh annual meeting of the American Laryngological Association, Washington, D. C., May, 1925.

1. Dean, L. W.: Infections of the Paranasal Sinuses in Infants and Young Children with Special Reference to Adenoids and Chronic Tonsillitis as Etiologic Factors, Ann. Otol., Rhinol. & Laryngol. **27**:534 (June) 1918. Dean, L. W., and Armstrong, Margaret: Nasal Sinus Disease in Infants and Young Children, Including Bacteriologic Study, Ann. Otol., Rhinol. & Laryngol. **28**:452 (June) 1919. Oppenheimer, Seymour: Accessory Nasal Sinuses in Children, J. A. M. A. **73**:656 (Aug. 30) 1919. White, Francis W.: Pathologic Nasal Accessory Sinuses in Children, Ann. Otol., Rhinol. & Laryngol. **30**:221 (March) 1921. Cleminson, F. J.: Nasal Sinusitis in Children, J. Laryngol. & Otol. **36**:505 (Nov.) 1921. Mitchell, Edward C., and Shea, John J.: Nasal Sinus Disease in Children, Arch. Pediat. **39**:230 (April) 1922. Dean, L. W.: Paranasal Sinus Disease in Infants and Young Children, South. M. J. **15**:846 (Oct.) 1922. Arbuckle, M. F.: Systemic Manifestations of Suppurative Disease in Paranasal Sinuses, J. A. M. A. **81**:741 (Sept. 1) 1923. Strachan, J. Grant: Chronic Sinusitis in Children, Canad. M. A. J. **13**:807 (Nov.) 1923. Jones, Arthur C.: Accessory Sinus Disease in Children, Northwest Med. **22**:339 (Nov.) 1923. Dean, L. W.: The Diseases of the Nose and Paranasal Sinuses, Abt's Pediatrics, Philadelphia, W. B. Saunders Company **3**:728, 1924.

tion had played. To see a child with deforming arthritis associated with severe bouts of fever become comfortable and afebrile, and to see function gradually restored as a result of treatment of sinus disease is impressive, especially when in former years one has been accustomed to see all efforts unavailing and the disease become progressively worse.

The local and general effects of sinusitis have been described [2] in our current and recent medical literature. To consider them here in any detail would be tedious. That part of these descriptions concerning the remote effects of sinusitis might be summarized, in part, by stating that any condition which may result from a focus of infection may result from sinus disease. Among such conditions may be included the following: cardiopathies, rheumatic fever, chorea, nephritis, pyelitis, certain cases of cyclic vomiting, deforming periarthritis, anemia, anorexia, malnutrition and chronic digestive disturbance. To these also may be added certain cases of neuritis and possibly erythredema (acrodynia).

Certain remote effects seem more or less peculiar to sinus disease. Several writers have emphasized the relationship between sinusitis and subacute laryngitis, bronchitis, bronchiectasis, some pneumonias and certain cases of asthma.

SYMPTOMS OF SINUSITIS

The possible symptoms and more or less local effects may be enumerated as follows: nasal discharge, nasal obstruction, epistaxis, sneezing, constant colds, pharyngitis, otitis, mastoiditis, catarrhal deafness, dizziness, cervical adenitis, chronic cough without lung pathology, headache, pains in the face and teeth, occult and recurrent fever, orbital cellulitis, retrobulbar neuritis, corneal ulcer, uveitis, epiphora, cavernous sinus phlebitis, meningitis, brain abscess, poor general health, sallow complexion, irritability, lethargy, lack of initiative, depression of cerebration and memory, poor school progress, hypersensitiveness, nervousness and inordinate fear of examination. The foregoing enumeration represents a compilation from the literature to which reference has been made. Surely this is an imposing array. Of course, only few of these

2. Byfield, Albert H.: Systemic Manifestations of Chronic Nasal Sinus Infections in Childhood, J. A. M. A. **71**:511 (Aug. 17) 1918. Webb, G. B., and Gilbert, G. B.: Bronchiectasis and Bronchitis Associated with Accessory Sinus Disease, J. A. M. A. **76**:714 (March 12) 1921. Mullin, W. V.: The Accessory Sinuses as an Etiologic Factor in Bronchiectasis, Ann. Otol., Rhinol. & Laryngol. **30**:683 (Sept.) 1921. Lemere, H. B.: The Diagnosis of Nasal Sinus Disease in Children, Arch. Pediat. **31**:601 (Sept.) 1922. Dean, L. W.: Complications of Paranasal Sinus Disease in Infants and Young Children, Ann. Otol., Rhinol. & Laryngol. **32**:285 (March) 1923. Byfield, Albert H.: Systemic Effects of Chronic Infection of the Upper Respiratory Tract, Abt's Pediatrics, Philadelphia, W. B. Saunders Company **3**:778, 1924. Coakley, Cornelius Godfrey: Paroxysmal Cough, a Frequent Symptom of Infection of the Paranasal Sinuses in Children, South. M. J. **17**:38 (Jan.) 1924.

conditions will be found in any one patient, though they are to be found in almost any combination. The conditions here listed do not represent an overstatement of fact. With the exception of the intracranial and some of the eye complications, the majority of the named conditions have been observed in our children's hospital during the past winter in association with sinusitis, and the conditions have been traceable more or less directly to this infection. It is not possible in such a paper as this to consider all of these phases of sinus disease. A few outstanding features only can be discussed.

MASKED MASTOIDITIS

An important manifestation which has been touched on only lightly in the literature is an acute illness in infancy, with symptoms referable chiefly to the gastro-intestinal tract and of such severity that death results if the condition is not relieved. In order to clarify the discussion of this condition, I wish to digress for a moment to refer to a group of cases observed in our clinic and falling under the head of masked mastoiditis.[3] In the course of the last winter we have seen several infants who suddenly developed symptoms of "cholera infantum" with diarrhea, fever, dehydration, intoxication and sudden marked weight loss, and who were proved to have acute mastoiditis, though the local signs by which mastoiditis might be diagnosed were insignificant or almost totally lacking. In those instances in which the mastoids were operated on, and in which recovery took place, the convalescence was rapid, and within a few hours of the operation very definite and marked improvement could be noted.

W. F. M. was 2 months old at the time she develeped symptoms exactly similar to those just related, and she recovered equally promptly on treatment of acute paranasal sinusitis.

It is not sufficiently appreciated that confined infection in infancy may cause such an acute disturbance with symptoms almost wholly referable to the gastro-intestinal tract and frequently leading to death if the infection is not found and treated adequately. Nor is it appreciated that such infection usually is located in connection with the upper respiratory tract. Dean [4] has reported several instances in which death in infancy seemed to be due to sinus infection exclusively.

The before mentioned patient, W. F. M., at a later time, illustrated the effect of chronic paranasal sinus infection on nutrition in infancy. After being at home for a time the infection recurred subacutely and she was returned with stationary weight, refusing or regurgitating much

3. Floyd, M. L.: Masked Mastoiditis Simulating "Alimentary Intoxication" (Anhydremia), Arch. Otolaryng. **1**:411 (April) 1925.

4. Dean, L. W.: Complications of Paranasal Sinus Disease in Infants and Young Children, Ann. Otol., Rhinol. & Laryngol. **32**:285 (March) 1923.

of her food and apparently feeling miserable. Without any essential change in her diet, all of the symptoms were relieved by treatment of the sinus infection.

In the publications mentioning gastro-intestinal disturbance in relation to sinusitis, the prevailing conception is that the digestive trouble is due chiefly to swallowed secretion. This scarcely seems a suitable explanation. In the mastoiditis cases referred to, swallowed secretion could not have been a factor. Infection alone probably is the chief factor in the sinus cases as well, whether it be acute, subacute or chronic.

SITE OF INFECTION

In the presence of rheumatic fever, chorea and heart disease, we are in the habit of thinking first of the lymphoid tissue of the throat as the site of an infectious focus. Nevertheless, everyone is familiar with the failure of tonsillectomy to prevent recurrence in many instances. Numerous examples might be cited indicating that on sinusitis also rests some of the responsibility. Two such examples will suffice.

D. S., aged 9 years, had chorea of four months' duration. She had had a complete tonsillectomy and adenoidectomy at the age of 7. In addition to chorea, she was found to have a moderate secondary anemia and to be 10 pounds (4.5 Kg.) underweight. As foci of infection, every paranasal sinus was found filled with pus, so thick in the maxillary sinuses that it was aspirated with difficulty.

G. Y., a girl, aged 7 years, had chorea; the tonsils had been removed, but some small stumps remained. In addition to the chorea, there was a moderate mitral insufficiency, well compensated and apparently inactive. The girl was markedly underweight and had secondary anemia. Chronic ethmoiditis was diagnosed. In about a month she had recovered completely from chorea, and seemed to be in excellent condition. The tonsil stumps were then removed, and it was expected that the sinus disease would clear up. The patient seemed to be quite well for two months, when she began to have fever and cough. After ten days of illness, she was seen again and found to have acute endocarditis. No possible focus was found except the sinus disease which had persisted. Convalescence was rapid following active treatment of this infection.[5]

NEPHRITIS

In 1923, Marriott and Clausen [6] pointed out the relationship between sinus infection and parenchymatous nephritis (nephrosis). All of the nephrosis patients studied had sinusitis and the causative organism was found to be a staphylococcus. The interrelationship was shown by the prompt disappearance of albuminuria and edema on free drainage of the sinuses. In February, 1925, Aldrich [7] reported three patients with

5. In February, 1926, this patient was in good health and had had no recurrence of any rheumatic manifestation.

6. Marriott, W. McKim., and Clausen, S. W.: Intoxications Associated with Alterations in the Physicochemical Equilibria of the Body Cells and Fluids, Tr. Am. Pediat. Soc. **35**:205, 1923.

7. Aldrich, C. A.: A Study of the Clinical Course of Generalized Edema, J. A. M. A. **84**:481 (Feb. 14) 1925.

nephrosis, in all of whom sinusitis was found, with prompt recovery following free drainage. In two of these patients staphylococcus albus was found in the pus. Apparently pus was not cultured from the third.

During the last winter, we treated three patients with nephrosis; in all three, maxillary sinusitis was found; in two patients the pus was quite thick; the third, definitely convalescent, showed only flakes of pus, though staphylococci were found to be present. For some reason pus from the first case produced no growth in culture; staphylococci were grown in the second case. The first patient died from streptococcus septicemia. The other two [8] have been operated on so recently that no further statement concerning them can be given.

The interrelationship between hemorrhagic nephritis and infection is undisputed. The infectious agent probably is a streptococcus in all instances, and its source is usually the tonsils. However, several writers have reported cases in which the sinuses seemed responsible, and the following case will serve to illustrate the same point:

H. B., a boy, aged 10 years, was admitted to the hospital on Dec. 8, 1924, with acute hemorrhagic nephritis, of which the first symptoms were noted on November 19; a uremic attack occurred on November 30. On admission, the urine was bloody and contained many casts. The patient improved with rest in bed and dietary care, and on February 10, when all evidence of nephritis had disappeared, tonsillectomy was performed, chronic tonsillitis having been diagnosed. Immediately following the operation, signs of nephritis reappeared. These all disappeared in two weeks, and after two weeks of freedom from signs he was allowed to go home. He returned for observation April 8, at which time many red cells were present in the urine and it was quite evident that the nephritis was active; the urine became normal within a few days. On April 18, at operation, he was found to have pansinusitis. The operative procedure was followed by another mild exacerbation. Within a week all evidence of nephritis had disappeared and the boy remained well until the time of writing. It cannot be said that this boy's troubles are over, but it is evident that a focus of infection existed after a clean removal of the tonsils and adenoids and that foci were found in the sinuses.[9]

HEADACHE

Many writers have reported instances of headache due to sinus infection. The following case may serve to emphasize this point:

J. W., a boy, aged 8 years, complained of headache and loss of appetite and it was suspected he had tuberculosis. The complaints were of one year's duration. At first, the headaches had occurred about once a week; they increased in frequency until they were occurring daily. After three weeks of study and

8. Complete examination of one of these patients in February, 1926, showed her to be entirely well. She has had no exacerbation of the nephrosis since she was discharged from the hospital nearly a year ago. The other patient had a stormy postoperative course and died from streptococcus septicemia and associated complications.

9. A letter from this boy's physician dated Oct. 13, 1925, states that the boy is in good health and that examination of the urine revealed no pathology. A communication from the patient in February, 1926, indicates that he has remained in good health.

observation, he was permitted to go home with the condition undiagnosed and untreated. He returned two months later at our request, at which time chronic suppurative disease of the ethmoid and sphenoid sinuses was diagnosed. The tonsils and adenoids had been removed at the age of 5 years. The temperature at times varied between 100 and 101 F., and was a feature of both periods of observation. Following active treatment of the sinus infection, the boy was discharged from hospital. A communication six weeks later stated that he has been entirely free from headaches since going home, and that he is improving physically.[10]

ASTHMA

Although asthma has been studied intensively by a considerable number of investigators, our information concerning this condition is still in an unsatisfactory state. Without entering into the details and merits of the arguments concerning the etiology of asthma, it may be stated that a relationship exists between nasal infection and asthma in some cases, and that this is attested by a considerable number of trustworthy observers. Our own experience supports such a conclusion. During the past winter, in several cases of long standing and frequently recurring asthma, the patients have been relieved by drainage of the paranasal sinuses and at the last report were free from attacks. One of these has been free since September and another since December.

CONCLUSION

Numerous other instances of the effects of sinus infection might be cited from our records, but this would be largely a repetition in different combinations of the various conditions and symptoms already noted.

Nothing original is claimed for any of the observations presented, but if this review serves to attract a little more attention to this phase of focal infection in childhood, it has served a useful purpose.

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10. This patient was seen on Feb. 7, 1926. It was stated that he had been entirely free from headaches since leaving the hospital with the exception of two mild brief attacks in September, 1925. Thus he has been practically free from headaches for one year.

SIGNIFICANCE OF THE LEUKOCYTE COUNT AS AN INDEX OF RHEUMATIC INFECTION IN CHILDREN *

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Although the specific causative agent of the rheumatic infection has not yet been demonstrated conclusively, the varied manifestations of the infection are now generally believed to be due to a micro-organism or to its toxin.

The conception of the rheumatic infection as being primarily a general infection, the extent and severity of the local manifestations depending on the intensity of the infection and the resistance of the child, is being more and more emphasized. In children, the rheumatic infection is characterized by periods of active infection followed by periods of quiescence, both being of uncertain duration, the infection involving indiscriminately, simultaneously and successively the heart, joints, skin and nervous system.

The determination of the onset, degree of activity, duration and quiescence of the rheumatic infection is of practical importance in diagnosis, prognosis and treatment.

The leukocyte count is taken as an index of infection in many diseases. Recently, Swift, Miller and Boots [1] concluded from a study of the leukocyte curve in patients with rheumatic fever that "the leukocyte curve is of prognostic value helping to point out the degree, severity and persistency of infection." In this investigation, an attempt has been made to evaluate the significance of the leukocyte count as an index of infection in children exhibiting the varied manifestations of the rheumatic infection.

MATERIAL AND TECHNIC

Routine white counts were made at each visit on children attending the heart clinic. A representative group was selected for follow-up, together with a group of rheumatic cases from the hospital ward. Leukocyte determinations were made at frequent intervals over a period

* Received for publication, March 26, 1926.
* Read at the Academy of Medicine, Pediatric Section, Feb. 4, 1926.
* From the Department of Pediatrics, Cornell University Medical School and the Heart Clinic of the New York Nursery and Child's Hospital.

1. Swift, H. F.; Miller, C. P. Jr., and Boots, R. H.: Leukocyte Curve as an Index of Infection in Rheumatic Fever, J. Clin. Investigation **1**:197-215 (Dec.) 1924.

of one to two years. A careful technic was maintained throughout the study. As a rule, the blood was taken from the middle finger, in a Bureau of Standards pipet, the same pipet being used throughout the study. A double Levy counting chamber was used and the average was taken for both counts. No counts were accepted when there was a difference greater than ten in both chambers. Counts were frequently checked. Blood smears were made in the usual manner, Wright's stain being used.

The majority of the clinic counts were done by one of us (K.). These were taken either at the morning clinic between 10 and 12, or in the afternoon clinic between 2 and 4. All children were examined at each visit to exclude conditions other than rheumatic infection which might influence the leukocyte count.

The ages of the children ranged from 4 to 15 years. In all, a total of 348 leukocyte counts on eighty-eight cases are included in this study.

The leukocyte count in children exhibiting the following rheumatic manifestations were studied:

1. Acute and subacute rheumatic fever with arthritis and fever.
2. Active chorea.
3. Recurring growing and joint pains (without fever or arthritis).
4. Rheumatic heart disease. This group was subdivided according to the classification of the Heart Association as follows: (*a*) Potential heart disease (history of previous rheumatic infection); (*b*) organic heart disease: 1. Class 1 (normal exercise tolerance, as indicated by normal vital capacity). 2. Class 2 A (slightly diminished exercise tolerance as indicated by vital capacity, from —10 to —25 per cent). Class 2 B (greatly diminished exercise tolerance as indicated by vital capacity, from —25 to —40 per cent). 3. Class 3 (cardiac failure as indicated by symptoms, physical examination and a vital capacity of from —40 to —70 per cent).

Averages of the leukocyte count obtained for each symptom group were computed. Frequently the same case will be present in more than one group.

The leukocyte counts were further arranged as to the time of the day, morning and afternoon, since Sabin and her co-workers [2] have recently shown that "the total number of white blood cells is increased in the afternoon regardless of whether food has been taken or not, and this entire increase is the result of an increase in the number of the neutrophilic leukocytes."

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2. Sabin, F. R.; Cunningham, R. S.; Doan, C. A., and Kindwall, J. A.: The Normal Rhythm of the White Blood Cells, Bull. Johns Hopkins Hosp. **37**:65 (July) 1925.

The leukocyte counts of children receiving and not receiving salicylates were compared, since it is known that salicylates influence the leukocyte count in rheumatic fever. Only the total leukocyte counts have been recorded for analysis, although differential counts were made in many of the cases. These showed the usual comparative increase in polymorphonuclear cells.

The upper limit of the average normal leukocyte count was considered to be 9,000 for this investigation. On final analysis of our data, however, the average leukocyte count in fifty-three children without any clinical symptoms of active rheumatic infection showed the upper limit of normal to average 7,000 white blood cells.

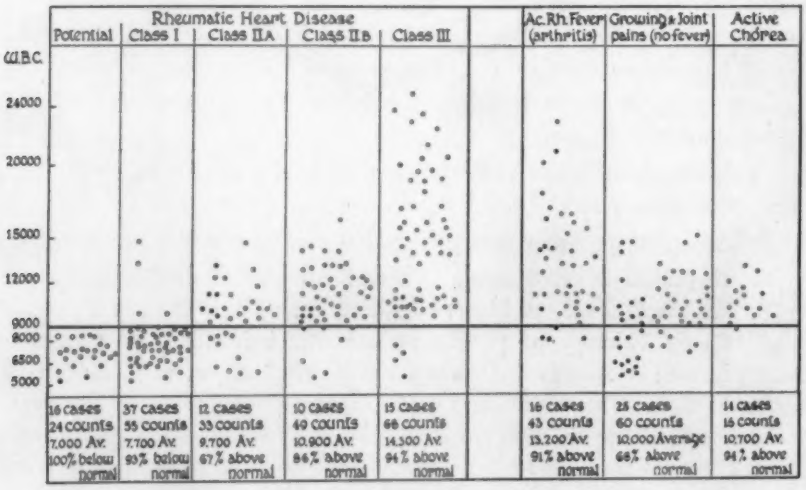

Chart 1.—The distribution of the leukocyte count in children with rheumatic infection. Black circle, salicylates; white circle, no salicylates.

RESULTS

A comparison of the individual and the average leukocyte counts obtained for each symptom group is of interest. These findings may be summarized as follows (chart 1):

For sixteen patients with acute and subacute rheumatic fever (with arthritis), the average leukocyte count was 13,200. The range was from 8,000 to 23,000, 91 per cent of the counts being above 9,000 white blood cells. Salicylates in the usual dosage tended to lower the leukocyte count but did not bring it down to normal at the height of the infection. Here, the degree of leukocytosis seemed to be proportional to the febrile reaction.

For fourteen patients with active chorea, the average leukocyte count obtained was 10,700 cells, with a range from 8,900 to 13,200 white blood cells, 94 per cent being above 9,000.

For twenty-five patients with an immediate history of recurring growing and joint pains (without fever, i. e., above 99, or evident arthritis), the average leukocyte count was 10,000 with a range of from 6,000 to 15,000; 68 per cent of the counts were above 9,000 white blood cells. Salicylates brought the count down to normal in many cases. The average count with salicylates was 9,000, compared with an average of 10,800 white blood cells for those not receiving salicylates. In many of these subjects, arthritis and carditis occurred during the period of observation. Frequently, the moderate leukocytosis observed in cases of growing and joint pains was the only indication of the infectious nature of these symptoms.

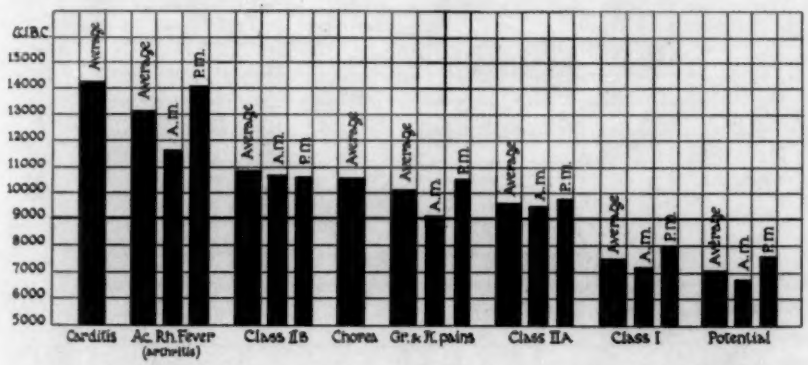

Chart 2.—The average leukocyte count in children with rheumatic infection. (The average morning and afternoon counts.)

LEUKOCYTE COUNT IN CHILDREN WITH RHEUMATIC HEART DISEASE

The average leukocyte count for sixteen of the potential group was 7,000, with a range of from 5,200 to 8,500 cells, 100 per cent being below the upper limit of normal.

The average leukocyte count for thirty-seven patients with chronic cardiovalvular disease (class 1) was 7,700 cells, with 93 per cent of the counts below 9,000. The range was from 5,200 to 9,900 white blood cells, with two subjects showing counts of 14,000 and 13,000 cells, respectively.

The low average leukocyte counts observed in these two groups were confirmative evidence of the quiescence of the infection as determined by clinical history, physical examination and vital capacity measurement. These average counts may also serve as control counts, indicating the upper and lower limits of normal.

The average leukocyte count for the twelve patients with rheumatic heart disease (class 2 A) was 9,700 cells with 67 per cent above 9,000, the range being from 5,000 to 15,000. These patients were afebrile and six had persisting rheumatic nodules. The majority of the children were convalescing from a previous carditis. In a few cases, the increased leukocyte count was the first evidence of the ensuing rheumatic carditis. This group includes the borderline cases, in which it is difficult to determine the activity or quiescence of the infection by physical examination alone.

The average leukocyte count for ten patients with chronic cardiovalvular disease (class 2 B) was 10,900, 86 per cent being above 9,000

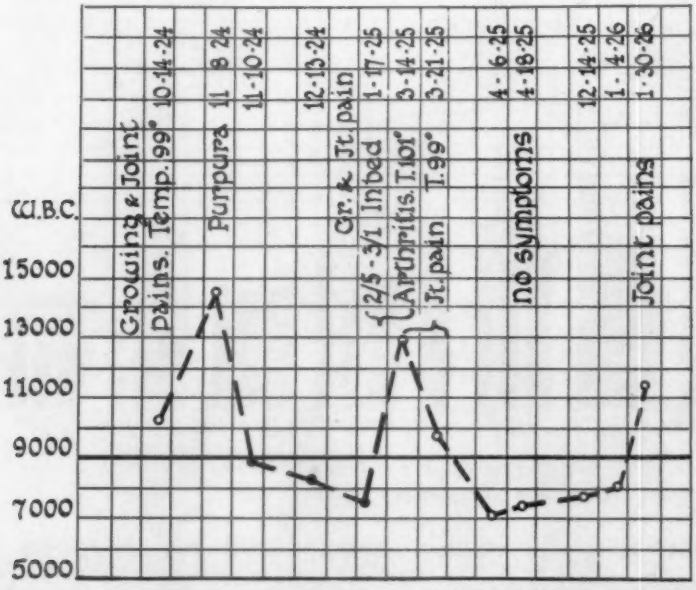

Chart 3.—Leukocyte curve in child with recurring growing and joint pains. Influence of salicylates on the leukocyte count. Black circle, salicylates; white circle, no salicylates.

cells, with a range of from 5,200 to 16,800. All of these patients were convalescing from a recent carditis without symptoms of cardiac failure. The associated symptoms of active infection were nodules, pallor and a low grade of temperature, from 99 to 100 F. In this group, the leukocyte count is of prognostic value, indicating the persistence or quiescence of the infection.

The presence of a low leukocyte count in some instances, despite the presence of other evidence of activity, is to be noted in passing.

In fifteen subjects with carditis (class 3), the average leukocyte count was 14,300, with a range of from 5,000 to 25,000 white blood cells,

94 per cent being above 9,000. These children had definite signs of cardiac failure; i. e., dyspnea, orthopnea and in some cases, edema. Other symptoms of infection were elevation of temperature from 100 to 103 F., nodules and pallor.

The leukocytosis here observed is confirmatory evidence that the symptoms of cardiac failure in childhood are due to active infection of the myocardium, rather than mechanical cardiac disablement.

The average leukocyte count for children receiving salicylates was 1,500 cells less than those not receiving salicylates for all groups. This

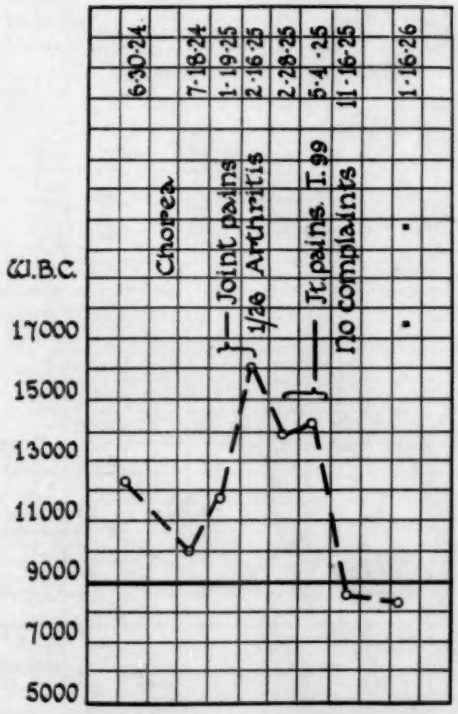

Chart 4.—Leukocyte curve in boy with growing and joint pains.

influence was particularly noted in patients with growing and joint pains. Frequently, individual counts were little influenced by salicylate medication, particularly at the height of the infection.

A further comparative analysis of the average leukocyte count for each symptom group is of interest (chart 2). Here it may be seen that the highest leukocyte counts were observed in the patients with carditis, the lowest in those with recurring growing and joint pains and class 2 A. The average counts for cases without clinical symptoms of activity were below the normal range.

If the grade of leukocytosis may be considered as an index of the degree of infection, these data would indicate that the most severe infection was present in the patients with carditis and a mild infection in patients with growing and joint pains. Such an inference would be in accord with the clinical course of the cases observed.

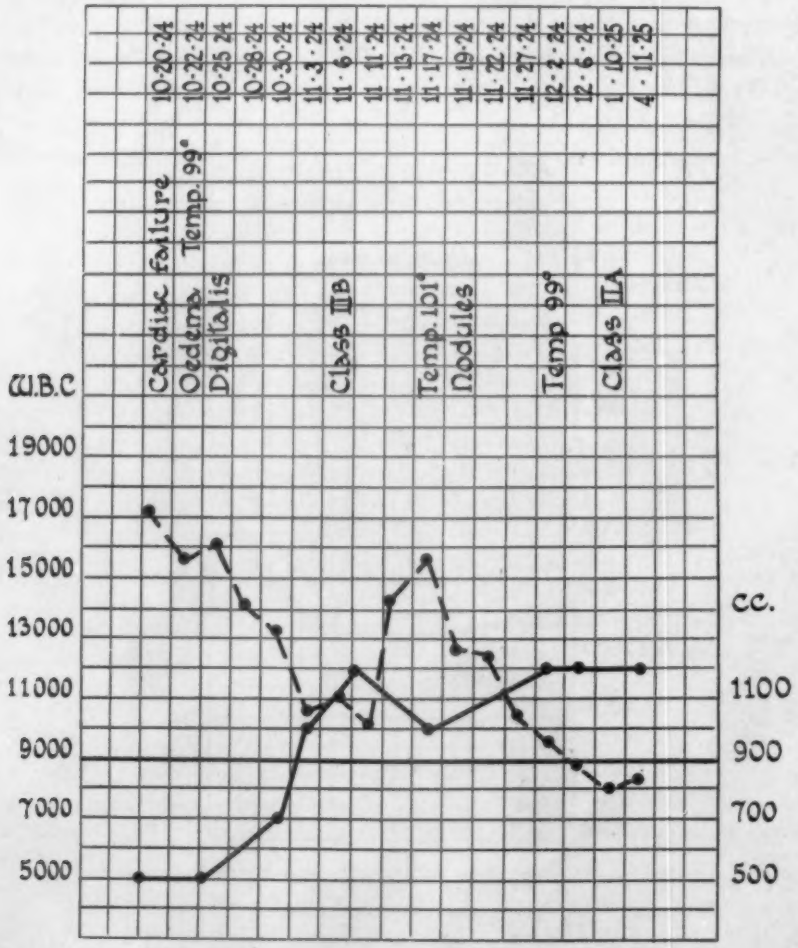

Chart 5.—Leukocyte and vital capacity curves of boy with cardiac failure. Vital capacity, plain line; leukocytes, broken line.

A comparison of the average leukocyte counts taken in the morning and in the afternoon (chart 2) shows, as a rule, a higher count in the afternoon. The average difference was 1,400 cells. In individual cases there were greater differences.

The following representative cases illustrate the clinical value of repeated leukocyte counts.

REPORT OF CASES

CASE 1 (chart 3).—A girl, aged 6 years, with potential heart disease has been observed since March, 1924. The chief complaint has been recurring growing and joint pains, with occasional purpura and arthritis of one day's duration. The latter was accompanied by a rise of temperature (from February 5 to March 1, 1925) from 99 to 101 F. The leukocyte curve is of interest, in that it shows a moderate leukocytosis during the period of joint pains. The normal count during salicylate therapy is also of interest.

CASE 2 (chart 4).—A boy, aged 15 years, had a mitral lesion of five years' duration. He complained of recurring joint pains for the last year. Before and after a moderate arthritis with fever, which occurred in January (from January 16 to Feb. 5, 1925) he has had severe joint pains, a temperature of 99 F. and a moderate leukocytosis. The latter was the only evidence of the infectious nature of the symptoms.

CASE 3 (chart 5).—A boy, aged 8 years, was admitted to the ward on Oct. 10, 1924, with a complaint of cardiac failure, edema and orthopnea. The temperature was 99 F., the leukocyte count 17,000 and the vital capacity 500 cc. (—70 per cent). Clinical improvement was associated with a rise in vital capacity and reduction of the leukocyte count. On November 17, exacerbation of the infection was accompanied by an elevation of temperature, rheumatic nodules and an increase in the leukocyte count to 15,000. Jan. 10, 1925, the leukocyte count was 8,000. The patient was allowed out of bed, and until April 18, when last seen, he showed no further evidence of activity of the infection.

CASE 4 (chart 6).—A girl, aged 8 years, on Oct. 18, 1924, six months after a severe carditis still showed a leukocytosis of 13,000. The clinical course up to the present time was characterized by periods of active carditis, nodules, purpura and leukocytosis. On Jan. 19, 1926, the leukocyte count was 10,000, the lowest it has been for two years. The case is illustrative of the long duration of active infection in some cases.

CASE 5 (chart 7).—A boy, aged 13 years, with chronic cardiac valvular disease, developed acute carditis on April 21, 1924. Convalescence was characterized by a gradual fall of the leukocyte count and a rise of the vital capacity to normal. This case is typical, and illustrates the prognostic significance of the leukocyte count. It also indicates the close correlation which exists betwen vital capacity measurements and the leukocyte count.

CASE 6 (chart 8).—A boy, aged 15, on Jan. 19, 1925, was found to have an aortic and mitral lesion (class I). The leukocyte count was 7,700. On February 2, following an unusual exposure, he developed acute carditis. On March 19, the only evidence of active infection was a moderate leukocytosis and slightly reduced vital capacity. The subsequent course was unusual. The vital capacity steadily decreased and was associated with pallor, loss of weight and rheumatic nodules. On May 22, the leukocyte count was below previous normal level. During convalescence, although clinical symptoms of infection disappeared and the vital capacity increased, the leukocyte count continued below the normal level.

COMMENT

Before discussing the possible significance of the leukocyte count as an index of the rheumatic infection, it is necessary to bear in mind the following:

1. In normal children there is a daily and hourly fluctuation in the leukocyte count.

2. It is a common experience to observe a moderate leukocytosis in apparently normal children.

3. A leukocyte count is but one bit of evidence in the final analysis.

The statistical consideration of the average leukocyte counts obtained in patients exhibiting the various manifestations of the rheumatic infec-

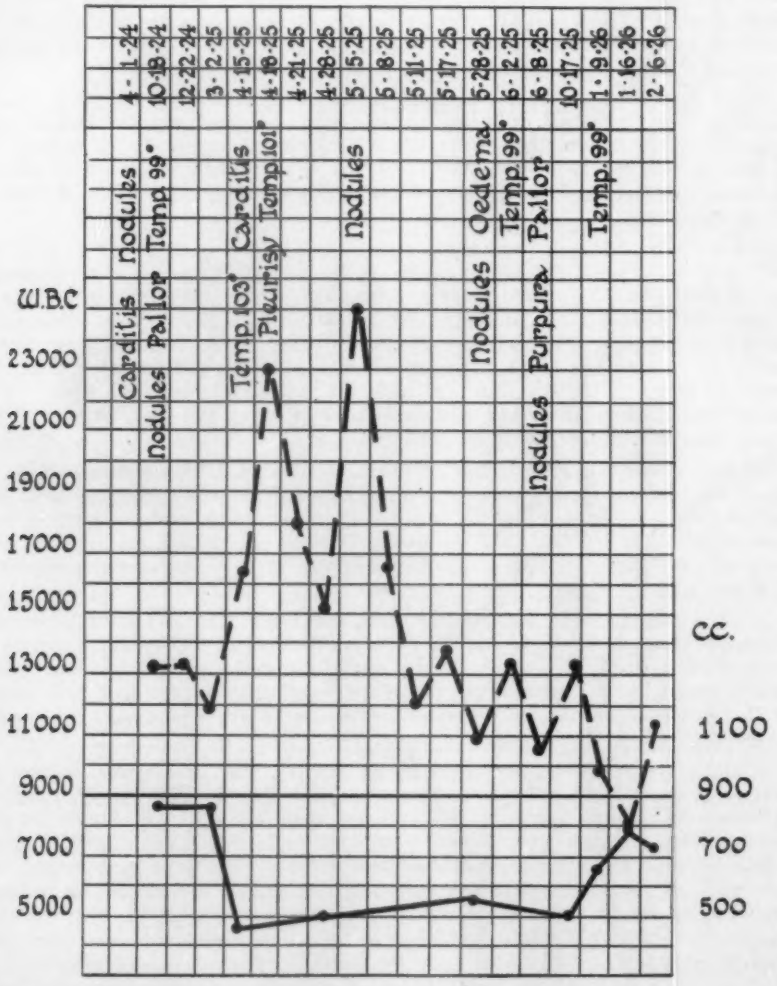

Chart 6.—Leukocyte and vital capacity curves of patient with persistent acute and subacute rheumatic carditis and rheumatic nodules. Vital capacity, plain line; leukocytes, broken line.

tion is of interest. Here it is shown in a striking way that average counts for cases without clinical symptoms of infection were below the upper limit of normal, and average counts of cases with active clinical symptoms of infection were above the upper limit of normal. The grade

of leukocytosis in each group seemed comparable to the intensity of the infection as observed clinically.

The low average leukocyte counts, from 7,000 to 7,700, which were obtained in the group of cases without clinical symptoms of rheumatic infection, seem to substantiate the use of 9,000 cells as the upper limit of normal in this study.

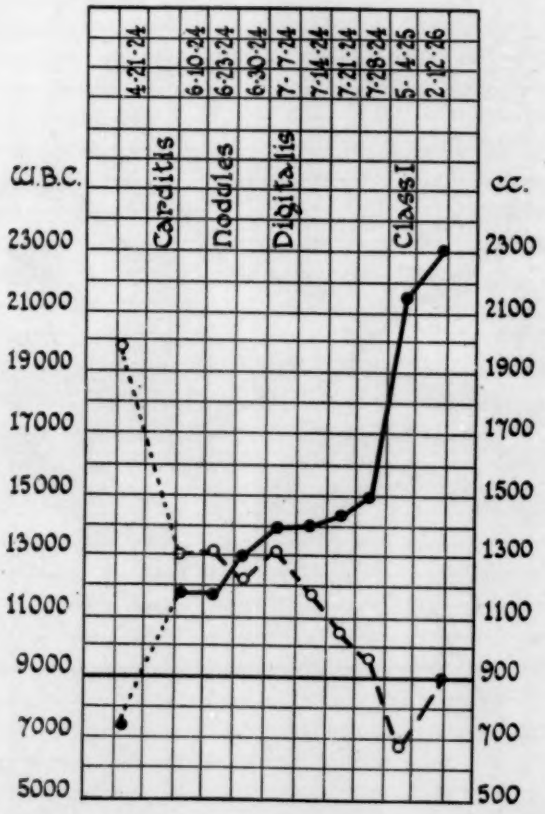

Chart 7.—Typical leukocyte and vital capacity curves of patient convalescing from acute carditis. Vital capacity, plain line; leukocytes, broken line.

An analysis of the individual leukocyte curves of cases observed over a prolonged period, however, indicates the value of establishing the average normal count for each case.

Of practical importance is the close correlation which seemed to exist between the leukocyte count and the vital capacity measurement in children with rheumatic heart disease.

It has been previously shown by Wilson and Edwards [3] that in children with heart disease, the vital capacity is an index of the cardiac reserve and that repeated vital capacity determinations follow closely the clinical course.

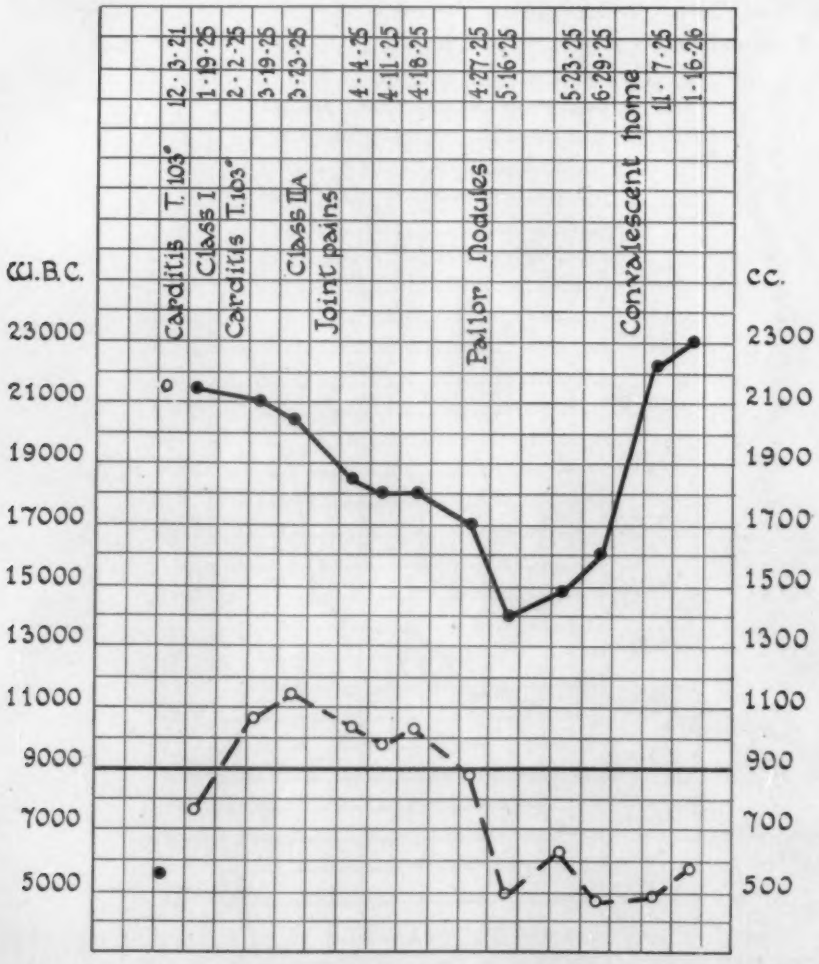

Chart 8.—Unusual leukocyte curve in patient with active rheumatic infection. Vital capacity, plain line; leukocytes, broken line.

If the presence of leukocytosis may be considered indicative of the degree of infection, and the vital capacity the efficiency of the myocardium, the close correlation which was observed between the leukocyte

3. Wilson, May G., and Edwards, D. J.: Vital Capacity of the Lungs and Its Relation to Exercise Tolerance in Children with Heart Disease, Am. J. Dis. Child. **22**:443-454 (Nov.) 1921. Wilson, May G.: Clinical Value of Vital Capacity and Exercise Tests in the Management of Children with Organic Heart Disease, M. Clin. N. Am. **8**:199-218 (July) 1924.

count and the vital capacity measurement in these cases might be expected, since both factors are closely related to the efficiency of the myocardium.

The information afforded by the leukocyte count would seem to be of practical value in the management of children with rheumatic heart disease, particularly those convalescing from an acute carditis.

SUMMARY

The average leukocyte count for children with a history of previous rheumatic infection (potential heart disease) was 7,000 cells.

The average leukocyte count for children with organic heart disease (class 1) was 7,700 cells.

The average leukocyte counts for children with active rheumatic infection (carditis, arthritis, chorea and recurrent growing and joint pains) were above 9,000 cells.

The correlation between vital capacity determinations and leukocyte counts in children with rheumatic heart disease confirms the modern conception of cardiac failure in children being primarily due to infection rather than to mechanical factors.

Leukocyte counts within the normal range may be considered as indicative of the quiescence of the rheumatic infection, and counts above the normal range indicative of activity of the infection.

Repeated leukocyte counts in children with rheumatic infection would seem to be of some clinical value in diagnosis, prognosis and treatment.

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XANTHOCHROMIA OF THE SPINAL FLUID IN THE NEW-BORN *

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DULUTH, MINN.

A spinal puncture made several months ago on a new-born infant with symptoms suggesting intracranial hemorrhage yielded a yellow fluid. Since then, the same type of fluid has been observed in four similar cases. A brief summary of the theories which have been advanced as to the cause of this phenomenon is here presented, together with the histories of the babies in this series.

The American literature on xanthochromia in the new-born is meager. During the last few years, Sharp and Maclaire [1] have published five or six papers dealing with the results of routine spinal punctures on five series of 100 consecutive new-born infants. In fourteen of these 500 cases, spinal fluid of varying degrees of yellow was obtained on the first puncture.

Most authors, including Sharp and Maclaire, advance three theories to account for this color. These theories have been styled: (1) the serogenic; (2) the hemolytic; (3) the jaundice.

THE SEROGENIC THEORY

This theory is also termed Froin's syndrome. The characteristics of such a fluid are: a bright yellow color, rapid, massive coagulation, high albumin and fibrinogen content, with increased cell count. It is found in vertebral, spinal cord and meningeal disease when obstruction to the flow of spinal fluid exists. Most observers believe that the characteristics of this fluid are due to a transudation of the blood plasma. Scully [2] describes the mechanism of its production as follows:

Obstruction of a portion of the spinal canal occurs, due to disease of the meninges, cord or vertebrae. This isolates a portion of the cerebrospinal space below the obstruction, thus forming a pouch or culdesac,

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* Received for publication, April 7, 1926.

* Read before the St. Louis County Medical Society, Duluth, Minn., November, 1925.

1. Sharp, M. A.: Intracranial Hemorrhage in the Newborn, J. A. M. A. **81**:620-624 (Aug. 25) 1923. Sharp, M. A., and Maclaire, A. F.: Intracranial Hemorrhage in the Newborn, Surg., Gynec. & Obst. **38**:200-206, 1924; Intracranial Hemorrhage in the Newborn, Tr. Am. A. Obst. Gynec. & Abdom. Surg. **37**:233; Further Observations of Intracranial Hemorrhage in the Newborn; Significance of Yellow Fluid and of Jaundice in These Cases, Am. J. Obst. & Gynec. **8**:172-185 (Aug.) 1924.

2. Scully, Francis J.: Yellow Spinal Fluid—Its Origin and Significance, Arch. Neurol. & Psychiat. **10**:83-99, 1923.

connection being broken off with the fluid above the obstruction. Decreased pressure below the point of obstruction allows dilatation of the pial veins, and makes it easy for transudation to occur. The degree and duration of obstruction determines the amount of transudation, as well as the amount of albumin in the fluid and the degree of massive coagulation. If the pressure has been insufficient to cut off the canal entirely, there occurs a fluid containing an abundance of albumin and globulin, though not in sufficient amount to cause spontaneous coagulation. Such a fluid, without cells, corresponds to what is known as Nonne's syndrome. Haynes [3] considers Nonne's syndrome as being merely a lesser degree of the same process that produces Froin's syndrome. The increased cell count is explained on the basis of inflammation of the meninges.

THE HEMOLYTIC THEORY

Haynes first described this condition in 1916, and termed it "erythrochromia." This fluid varies from a brownish-red to a deep amber, and its color may change from day to day. It contains red blood corpuscles or their shadows, does not clot, and the tests for hemoglobin are positive. Haynes believes such a fluid is due to varying degrees of hemorrhage or to a mild transudation from the pial vessels into the fluid. It may be found in cases of inflammation, neoplasm or trauma. Its color is due to dissolved hemoglobin or its derivatives. It usually occurs without demonstrable compression of the cord.

CASES ASSOCIATED WITH JAUNDICE

Levinson [4] states, "In marked jaundice, the fluid often has the color of bile," and again, "The color of the fluid in jaundice is often deep yellow, and gives a positive bile test; otherwise, it is negative."

Roberts [5] reports a series of 423 cases, in which a spinal puncture was done on new-born colored infants during the first 24 hours of life. Sixty of these subjects showed blood in the spinal fluid. The remaining 363 all showed some degree of pigmentation, varying from a pale straw to deep yellow. In no case was there any evidence of jaundice during the twenty-four hour period in which the primary puncture was done. Roberts has been able to confirm the presence of bilirubin in the serum of these infants, and in addition has found that it exists constantly in the spinal fluid. The pigment persists in the fluid at least until the ninth day, and disappears by the fourth week. It is further stated that rarely

3. Haynes, Frederick M.: The Spinal Fluid Syndromes of Nonne and Froin and Their Diagnostic Significance, Am. J. M. Sc. **152**:66-71, 1916.

4. Levinson, Abraham: Cerebrospinal Fluid, ed. 2, pp. 133 and 209.

5. Roberts, M. Hines: The Spinal Fluid in the Newborn, J. A. M. A. **85**: 500-503 (Aug. 15) 1925.

is there a fluid found which does not contain at least an occasional red blood cell, if sufficient diligence is expended in the search. It is his impression that xanthochromia is not dependent on intracranial hemorrhage, but is undoubtedly intensified by it.

Sharp and Maclaire believe that yellow fluid obtained during the first twenty-four hours of life is due to varying degrees of transudation of the blood plasma produced by venous congestion or partial asphyxia, or by minute hemorrhage. The cases here reported are considered as belonging to this category.

The following brief reports are presented:

CASE 1.—F. was the second child of a healthy mother, aged 30. The position was right occiput anterior. The labor was short, full dilation occurring in five hours. Chloroform was given in the last stages. Forceps were applied when the head was ready for delivery.

Examination of the baby on the day of birth disclosed nothing abnormal. Three days later the child was seen again because of vomiting and considerable loss of weight. The only abnormal finding at this time was jaundice estimated at 2 plus on the scale of 4. On the next day the child continued to vomit practically everything given, in spite of the usual methods to correct this. At 4 the following morning, the temperature rose suddenly to 108 F. This was substantiated by several thermometers. It rapidly fell to 101.2 F. No new findings were encountered on physical examination. A disturbance of the heat regulating center due to hemorrhage was suspected. Spinal puncture was done; 25 cc. of cloudy yellow fluid came from the needle drop by drop. Immediate microscopic examination of this fluid showed numerous crenated red blood cells. Unfortunately, these were not counted. After the puncture, all food and water were retained for the day. The temperature rose again to 104.2 degrees at noon, but fell to normal by evening. The general condition continued to improve. The child has been examined several times since, and at the age of 6 months appeared normal in all respects.

CASE 2.—F. was the first baby born of a healthy mother, aged 28. The duration of labor was twenty hours. The position was left occiput anterior. Ether was used in the last stages and low forceps were applied. The baby was first seen by me three days after birth, because of considerable weight loss and vomiting. The general physical examination at this time showed nothing abnormal. During the next three days, the child vomited about half of the food and water taken. Six days after birth the physical examination again showed no abnormalities. A spinal puncture yielded 25 cc. of turbid yellow fluid, which poured forth first in a steady stream. Immediate microscopic examination showed a few red blood cells, about 70 per cent of which were crenated. The child vomited once more that day but none thereafter, and the improvement was steady. Another puncture was done on the ninth day and yielded 4 cc. of fluid, which was again of a yellow color but was not studied microscopically. Coagulation and bleeding times on the second day of life were not prolonged. This child was reexamined at the age of 6 weeks, and appeared quite normal.

CASE 3.—B. was the first baby of a healthy mother, aged 26. The duration of labor was eleven hours. The position was left occiput anterior. Chloroform was used in the last stages. The delivery was spontaneous and without incident. Examination of the child on the day of birth showed nothing abnormal except slight cyanosis of the hands and feet. The child was seen four days later because of vomiting, and at this time some degree of skin dehydration was noticeable. Examination otherwise was negative. The child vomited about 80 per cent of the food and water taken during the next forty-eight hours. Physical

examination six days after birth again showed nothing abnormal. A spinal puncture was made, with the removal of 15 cc. of distinctly yellow fluid, flowing forth in a steady stream. Immediate microscopic examination of this fluid showed a few crenated red blood cells. The child continued to vomit about half of the food and water taken during the following twenty-four hours, then this vomiting ceased abruptly, and the child improved steadily. When again seen at the age of 5 months, it appeared entirely normal.

CASE 4.—K. was the first child of a healthy mother, aged 25. The duration of labor was thirty-five hours. The position was left occiput anterior. Ether anesthesia was used in the last stages and low forceps were applied.

Examination of the baby on the day of birth showed it to be normal with the exception of a slight caput succedaneum. The child was again seen two days later because of vomiting. At this time the fontanel was depressed. The child continued to vomit water and part of the food until the fifth day. Physical examination at that time showed slight cyanosis, and jaundice estimated as 3 plus. A spinal puncture yielded 30 cc. of a clear, yellow fluid coming from the needle drop by drop. Immediate microscopic examination of this showed 20 red blood cells per cubic millimeter, 50 per cent of which were partially crenated. Vomiting ceased immediately after the spinal puncture. There was no more cyanosis and steady improvement occurred. At the age of 6 months this child appeared entirely normal.

CASE 5.—H. was the fourth child of a healthy mother, aged 34. The duration of labor was four and one-half hours. The position was left occiput anterior. Chloroform was used in the last stages and low forceps were applied. The child was examined on the second day of life and showed no abnormality. On the fifth day the child had an attack, during which it seemed much fatigued, lay motionless and was very listless. Two similar attacks occurred later in the day. The physical examination at this time showed nothing abnormal. A spinal puncture was made, which yielded 8 cc. of pale yellow fluid, the last part of which was blood-tinged. Immediate cell count of the clearest fluid showed 350 crenated red cells per cubic millimeter. No further attacks were noted after this puncture, although the child always remained rather sleepy.

The patient was reexamined on the eighth day, with no abnormal findings other than 1 plus jaundice. The spinal puncture was repeated, yielding 12 cc. of a very pale, yellow clear fluid, coming from the needle drop by drop. This fluid was definitely less yellow than that previously examined, and under the microscope showed 28 red blood cells per cubic millimeter, 50 per cent of which were crenated. A test of this fluid was negative for bile. An albumin test yielded a 2 plus reaction. I have not seen this child since it left the hospital, but the physician in charge reported it to be normal at the time of writing.

COMMENT

A series of five new-born infants with xanthochromia of the spinal fluid is here presented.

The color of the fluid varied from a pale yellow to a bright canary. All these fluids showed red blood cells, either all or in part crenated, when examined a few minutes after withdrawal. No difficulty was encountered with any of the spinal punctures. They were what might be termed "clean punctures," in that there was no evidence of macroscopic blood at the time. Some signs of intracranial disturbance were noticed before punctures were done in all these cases. These signs, in the order of their frequency, were: uncontrollable vomiting, listlessness, mild cyanosis, nystagmus and a very high temperature.

Owing to my lack of acquaintance with this type of fluid, complete laboratory studies were not made. In the one fluid tested, bile was found to be absent, but albumin was reported as 2 plus. Jaundice, varying from 1 to 3 plus, was present in three cases. Improvement, as evidenced by the disappearance of the signs which suggested the punctures, occurred within twenty-four hours in all cases. Only one puncture was made in three of the five cases. In the fifth case, a second puncture, made three days following the first, yielded a paler yellow fluid than first obtained, with a decided decrease in the number of red cells. Ventricular or foramen magnum puncture was not made, as neither seemed indicated.

There is evidence, based on the characteristics of these fluids and the clinical course of these infants, that yellow fluids such as are here described are related to previous intracranial blood vessel derangement, producing either transudation of blood plasma, frank hemorrhage, or both. The etiologic agent may be intracranial congestion occurring during labor.

The material here presented is purely clinical. Further knowledge of this condition will be gained only as such fluids are examined more carefully, with particular reference to coagulability, albumin content, cell content and the presence or absence of bile and hemoglobin or their derivatives.

METABOLISM OF UNDERNOURISHED CHILDREN*

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INTRODUCTION

The work reported in this and subsequent papers was undertaken at the request of the trustees of the Elizabeth McCormick Memorial Fund of Chicago. This organization has been interested for a number of years in the practical task of attempting to overcome, by the organization of nutrition classes and by work in the home, undernutrition in children of school age. The work has, in general, been successful, but a small proportion of the children who have come under observation could not be made to gain, in spite of the fact that no evident cause of the undernourished state could be detected. It was to determine the metabolic abnormality, if any actually existed, of such "refractory" children that the Nelson Morris Institute was asked to investigate the subject at the suggestion of Dr. I. A. Abt, consulting pediatrician of the fund. In outlining the work to be undertaken, it was considered necessary to study not only supposedly refractory children, but as large a series as possible of children of school age showing various degrees of undernutrition, whether or not they might later be found to be refractory. It was also believed to be necessary to study a group of normal children of the same ages.

Financial support for a period of five years was promised by the Elizabeth McCormick Memorial Fund, and additional support for the same period has been received from Mrs. Francis Neilson, Mrs. Gusta Morris Rothschild and Mr. Melville M. Rothschild. The Otto Baer Fund for Clinical Research of the Michael Reese Hospital made a grant of money sufficient to cover the cost of the apparatus required. The hospital itself has provided a room for a basal metabolism laboratory in the Sarah Morris Hospital for Children, a small ward for the children under study, a special diet kitchen for use in connection with the work, current supplies for carrying on the work, and maintenance for the

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* From the Nelson Morris Memorial Institute for Medical Research of the Michael Reese Hospital, Chicago. Aided by a fund contributed jointly by the Elizabeth McCormick Memorial Fund, Mrs. Francis Neilson, Mrs. Gusta Morris Rothschild and Mr. Melville M. Rothschild.

children and for those members of the working staff who live in the hospital in order to be in constant touch with the children.

The investigation has been under the immediate control of the Department of Chemistry of the Nelson Morris Institute. The staff of workers, who have devoted their full time to the investigation under the direct supervision of the head of the Department of Chemistry, has consisted of an assistant in charge of the basal metabolic determinations; an assistant for the chemical work; a dietitian who was responsible for the preparation of the food and for the feeding of the children; two assistants who lived in the hospital were in charge of the children at all times, and attended to the collection of specimens. The physical examination and medical care of the children selected for study were in the charge of Dr. I. A. Abt, attending pediatrician of the Michael Reese Hospital, whose constant interest in the problem has been a source of inspiration. No child was accepted for study who had any physical defect which might be a factor in bringing about the condition of undernutrition. The children used as subjects were obtained through the Elizabeth McCormick Memorial Fund, the social service department of the Michael Reese Hospital, the outpatient metabolic clinic of the Michael Reese Dispensary, the Jewish Orphans' Home, and a number of other social service organizations; to all of these, grateful acknowledgment is made of the help rendered. It is a pleasant duty to acknowledge the constant support which the work has received from the late Mrs. Ira Couch Wood, former director, and from Miss Mary Murphy, present director, of the Elizabeth McCormick Memorial Fund.

The work is still in progress, but sufficient data relating to certain phases of the investigation have been gathered to warrant publication.

I. GAIN IN WEIGHT

Undernourishment in children has long been an accepted condition, and many remedial measures have been developed, but little has been established concerning the nature of such deviation from normality. The present investigation was undertaken in order to determine whether certain chemical processes differ in undernourished children from those of normal children. Our work covers studies of basal metabolism, nitrogen balance, calcium and phosphorus balance, caloric utilization, and the excretion of creatine, creatinine and ammonia.

The present report is concerned with the gain in weight of thirty-three underweight children, who remained in the hospital for periods varying from two weeks to five months. These children were sent to us from various organizations and were, in great part, children who had failed to gain weight while attending nutrition classes. Many were sent with the statement that they were children who could not gain, no

matter how hard they tried. Our work has not borne out such an assumption, as the table which appears later will show. Nine normal children are also included in the following tables.

The children are well taken care of in the hospital. There is an attendant with them at all times to look after their physical needs, to supervise their playroom activities, and to take them outdoors, in short, to keep them well and happy. Their meals are prepared by a special dietitian. The hospital maintains a playroom in charge of an experienced kindergarten teacher, to which they have access at all times. There is also a good library for children so that the best of facilities are provided in every respect. The children are happy and contented while here, and often ask to come back after they have been discharged. Before admission the children are given a medical examination, and if they show any active pathologic condition other than underweight, they are not accepted for research work. During the early part of the work the children were kept just long enough to secure basal metabolism records and to run one diet. They were then returned to the agency which sent them for treatment, with the understanding that they would come back to us after they had reached normal weight. All of the children attended nutrition classes for undernourished children. It was difficult, however, to carry out this plan, because in many cases the home did not cooperate and the children failed to gain weight; others dropped out of sight and were lost to us. So later we adopted the expedient of keeping the children for longer periods until they had attained normal weight here in the hospital.

There is, of course, always the possibility of a connection between underweight or malnutrition and conditions other than chemical or metabolic factors. We feel, therefore, that some significant observations concerning the children should be recorded here.

CAUSES OF MALNUTRITION

Nationality.—Two-thirds of our subjects came from Jewish, Polish, Irish and Italian families, all of whom are ordinarily considered to be quite excitable. Most of the representatives here ran true to form. The relatives, especially, were deeply concerned over every trifling event when they came to visit the children in the hospital. Sometimes they would urge a child to beg to be allowed to return home, and the child would be upset for hours after their visits. A parent would be filled with resentment if a child was happy here or furiously angry if he could persuade the child that it was not happy. Lack of cooperation was usually overcome without a great deal of difficulty, however, and indeed in the majority of cases it did not occur at all. It is evident that most of our subjects were of a highly excitable nature,

and it must not be overlooked that emotional disturbances might have some significant connection with underweight. On the other hand, most of our control children possessed similar characteristics, since most of them were Jewish.

Home Conditions.—In some cases, orthodox religious observances demanded certain food restrictions or peculiarities which had to be honored. Aside from these there were certain rather common features in the food habits of the children. Most of them were consulted at home as to their likes and dislikes, and allowed to choose their own foods regardless of the fact that their choice was usually bad. Many of the children had been allowed to eat freely of foods of high flavor, such as pickles or candy, and they did not relish the plainer vegetables which seemed tasteless in comparison. Then, too, most of them ate between meals whenever they happened to be hungry, so that at meal time they had no appetite.

Individual Variations from Normal Children.—Food Habits: The underweight children were almost invariably slow eaters. They came to the table without appetite and they would dawdle over a meal for hours if allowed to do so. Normal children, on the other hand, were hungry at meal time, ate quickly, and were off to something else. Probably some of the children, especially those of school age, did not get enough to eat because they could not eat a meal in the time off from school at noon. They had not been trained to eat properly. Often they would chew for several minutes without making any attempt to swallow. In the matter of strange foods, too, the normal children would eat them much more readily than those underweight. The latter were suspicious of anything they had not had at home, or of anything that was cooked in a different way and would refuse to taste it, insisting that they did not like it. It is interesting to note here that children easily learn to regurgitate food on very slight pretext.

Play Habits: Our underweight children were almost all very apathetic. They had no initiative in play, but had to be drawn into the play of the other children by various means. When normal and underweight children were with us at the same time, the underweight children would be tired out when the normal ones were still fresh and active. Only something unusual or sensational would appeal to those underweight, and then they would maintain a state of excitement much longer than the normal children. This often resulted in inability to eat the next meal, or in failure to retain it if eaten.

Personal Hygiene: Perhaps the most significant factor in personal hygiene is the rarity of the individual toothbrush. The effect of bad teeth on malnutrition is too well known to require comment.

EXPERIMENTAL

We have arbitrarily fixed our standard of underweight children at more than 5 per cent. below the figures given as normal for age and height by Baldwin and Wood of the Child Welfare Research Station, State University of Iowa. Twenty-two of the thirty-three children, however, were more than 10 per cent below normal. Nearly all of the children were below normal height for their age as well, using the Woodbury standards, and this fact complicated our dietary problem somewhat. It was originally planned to give each child a caloric intake which would be desirable for a child of the same age and of normal weight and height. This in some cases made the intake quite high as compared with Holt's recommended caloric intake per kilogram of body weight. In some cases, however, it was impossible to persuade the child to eat so much, and in a few cases the child was still hungry after taking the amount prescribed, and was allowed to have a little extra food. A typical day's dietary included the following foods: Milk, meat or fish, egg, potato, a vegetable such as carrot, tomato, celery, spinach or raw cabbage, orange or other fruit, white bread, butter, cereal and cocoa. Ice cream was a frequent dessert. While the children were on a controlled diet, the food was carefully weighed for three days preceding the analysis and for three days when excretions were being collected and analyzed.

Table I shows that four children neither gained nor lost weight and two lost slightly during their stay here. Three of the children who showed no gain were normal and would not be expected to show a change in weight in so short a period as two weeks. No child who stayed more than two weeks failed to gain. Eleven of the underweight children had attained normal weight when they left, and only eight were more than 10 per cent below normal on their discharge. It is interesting to note that only one child who was here more than three weeks failed to come within the 10 per cent class, and this was a girl, aged 7 years, who was clearly far below the average mentally as well as physically. There seemed to be no difference between boys and girls in respect to ease in gaining weight. The figures reported cover fourteen boys and twenty-eight girls.

In table 2, the children are arranged according to age, and their gain in weight each day is computed in terms of grams per kilogram of body weight. The most striking fact to be noted here is that the gain is considerably greater in children below 6 years of age. It is conceivable, at least, that the period of dentition setting in shortly after this time may be accompanied by digestive disturbances, and a consequent slackening of the rate of gain in weight. The two normal

children in the 4 and 5 year age groups show a lower gain in weight per day than the average for the group, but, on the other hand, in the 8 year groups the normal child displays the greatest gain. The normal children in other groups show no gains or slight ones, as would be expected. Averages are given in the table for each age group, but aside from such differences as have been noted between the very young children and the older ones, these figures are not necessarily significant

TABLE 1.—*Weight Increase of Undernourished Children in Varying Time Intervals*

Subject	Sex*	Age	Duration of Stay, Days	Weight				
				On Entry, Kg.	Variation from Normal per Cent	On Leaving, Kg.	Variation from Normal per Cent	Gain per Cent
G. L.	♀	13	10	33.9	−5.6	33.7	−6.1	−0.6
T. F.	♂	10	10	23.4	−9.7	23.8	−8.1	1.7
I. Ba.	♂	10	11	30.7	−3.5	30.8	−3.1	0.3
B. L.	♂	11	11	31.1	−2.2	31.1	−2.2	±0.0
J. M.	♂	13	11	27.5	−12.1	28.2	−9.9	2.5
A. Go.	♀	8	12	17.8	−26.1	18.0	−25.3	1.1
C. S.	♂	10	12	26.9	−9.7	27.5	−7.7	2.3
R. N.	♀	11	13	25.2	−25.0	25.5	−24.1	1.2
H. L.	♀	8	13	19.3	−10.6	19.7	−8.8	2.1
L. A.	♀	10	13	22.9	−13.6	22.7	−14.3	−0.9
D. Y.	♀	7	13	17.1	−17.0	17.3	−16.0	1.2
H. S.	♀	9	13	26.8	−5.0	26.8	−5.0	±0.0
M. H.	♀	9	13	23.9	+3.0	23.9	+3.0	±0.0
S. W.	♀	8	13	20.9	−8.2	22.1	+2.3	5.7
R. W.	♀	11	13	34.7	+6.1	35.7	+7.9	1.7
B. G.	♀	9	14	20.6	−8.0	20.6	−8.0	±0.0
R. M.	♂	5	15	13.6	−5.5	14.7	+2.1	8.1
M. M.	♂	7	15	17.8	−12.3	18.1	−10.8	1.7
H. P.	♀	4	15	16.6	−0.6	17.4	+0.6	4.8
B. G.	♀	8	16	19.1	−13.6	19.9	−10.0	8.9
L. P.	♀	8	16	22.3	−20.8	22.6	−19.8	1.3
E. B.	♀	5	16	14.5	−13.2	16.6	−0.6	14.5
R. B.	♂	6	18	15.0	−21.4	16.9	−11.5	12.7
M. S.	♀	9	18	21.2	−12.0	22.0	−8.7	3.8
H. G.	♂	11	19	26.4	−14.3	27.8	−9.7	5.3
J. R.	♀	4	20	14.5	−11.6	16.1	−1.8	11.0
R. G.	♀	10	20	27.0	−6.3	28.6	−0.7	5.9
F. J.	♀	10	20	26.8	−5.0	27.6	−2.1	3.0
H. D.	♂	5	25	12.9	−6.5	14.2	+2.9	10.1
A. Ge.	♀	5	27	16.6	−4.2	18.3	+2.8	10.2
B. B.	♀	5	27	11.2	−17.7	13.4	−1.5	19.6
E. D.	♂	10	30	24.8	−8.8	25.4	−6.6	2.4
M. Da.	♀	4	34	12.8	−12.9	15.4	+4.8	20.3
M. Do.	♀	7	53	18.1	−15.4	19.2	−13.1	6.1
S. K.	♂	10	62	25.2	−17.3	27.6	−9.5	9.5
N. G.	♂	7	64	14.7	−14.0	16.9	−1.2	14.9
R. G.	♂	6	74	15.6	−9.8	17.1	−3.4	9.6
J. G.	♂	8	74	21.6	−6.1	23.9	−0.4	10.6
L. C.	♀	6	75	17.3	−14.8	18.7	−7.9	8.1
E. G.	♀	6	76	16.7	−6.2	18.2	−0.5	9.0
A. B.	♀	6	122	16.0	−22.3	19.4	−7.2	21.2
A. Go.	♀	10	160	20.1	−26.9	27.3	−7.1	35.8

* In this column, ♀ indicates female; ♂, male.

because of the small number of children in each group. When all of the figures in the group show the same trend, however, we feel that they are significant. Here, again, there is no difference in the behavior of the sexes.

The degree of underweight seems to have no effect on the rate of gain. A child who is 20 per cent underweight runs much the same

course as one who is only 6 per cent below normal. Individual differences here surpass group differences.

The chart shows a number of the individual curves for children who remained with us for four or more weeks. In order to start all these curves on the same base line, the weight of the child, on entry was arbitrarily set at 100, and his weight each subsequent week was referred to this figure. The curves are plotted according to the time of

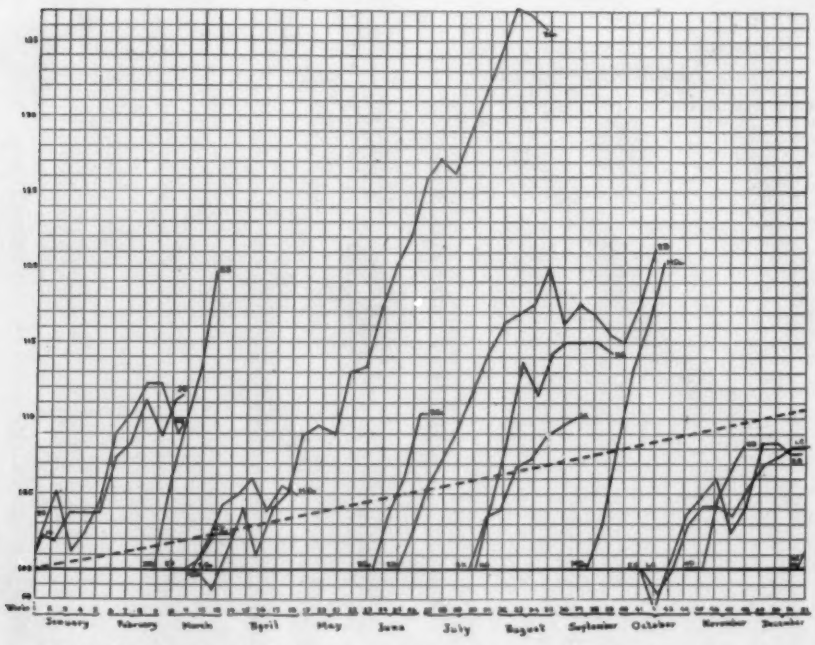
TABLE 2.—*Relation Between Age and Weight Increase of Undernourished Children*

Subject	Age	Sex*	Variation from Normal Weight, per Cent	Caloric Intake per Kg.	Total Gain During Stay, Kg.	Gain per Kg. per Day, Gm.
J. R.	4	♀	−11.6	83	1.6	5.5
H. P.	4	♀	−0.6	95	0.8	3.2
M. Da.	4	♀	−12.9	138	2.6	6.0
H. D.	5	♂	−6.5	92	1.3	4.0
R. M.	5	♂	−5.5	94	1.1	5.4
E. B.	5	♀	−13.2	109	2.1	9.0
B. B.	5	♀	−17.7	103	2.2	7.3
A. Ge.	5	♀	−4.2	110	1.7	3.8
R. B.	6	♂	−21.4	97	1.9	7.0
R. G.	6	♂	−9.8	105	1.5	1.3
E. G.	6	♀	−6.2	83	1.5	1.2
L. C.	6	♀	−14.8	84	1.4	1.1
A. B.	6	♀	−22.3	89	3.4	1.7
M. M.	7	♂	−12.3	90	0.3	1.1
N. G.	7	♂	−14.0	93	2.2	2.3
D. Y.	7	♀	−17.2	91	0.2	0.9
M. Do.	7	♀	−15.4	77	1.1	1.1
J. G.	8	♂	−8.1	86	2.3	1.4
B. G.	8	♀	−13.6	109	0.8	2.6
A. Go.	8	♀	−26.1	66	0.2	0.9
H. L.	8	♀	−10.6	79	0.4	1.6
L. P.	8	♀	−20.8	72	0.3	0.8
S. W.	8	♀	−3.2	98	1.2	4.4
B. G.	9	♀	−8.0	81	0.0	0.0
M. S.	9	♀	−12.0	96	0.8	2.1
H. S.	9	♀	−5.0	76	0.0	0.0
M. H.	9	♀	+3.0	76	0.0	0.0
I. Ba.	10	♂	−3.5	57	0.1	0.3
C. S.	10	♂	−9.7	67	0.6	1.9
E. D.	10	♂	−8.8	70	0.6	0.8
T. F.	10	♂	−9.7	79	0.4	1.7
S. K.	10	♂	−17.3	88	2.4	1.5
L. A.	10	♀	−13.6	..	−0.2	−0.7
A. Go.	10	♀	−26.9	96	7.2	2.2
R. G.	10	♀	−6.3	77	1.6	3.0
F. J.	10	♀	−5.0	78	0.8	1.5
H. G.	11	♂	−14.3	72	2.4	4.8
R. N.	11	♀	−25.0	50	0.3	0.9
R. W.	11	♀	+6.1	65	1.0	2.2
B. L.	11	♀	−2.2	68	0.0	0.0
J. M.	13	♂	−12.1	76	0.7	2.3
G. L.	13	♀	−5.6	63	−0.2	−0.6

* In this column, ♀ indicates female; ♂, male.

year at which the child was under observation, although not all cases belong to the same year. From the curves which we have plotted we do not feel justified in drawing any conclusions whatever as to effect of season on the rate of gain. It is significant to note that all children did gain weight, and that gain was far in excess of the amount to be expected for normal children. Losses which occurred can almost always be explained by such notes as "slight cold," "homesick," "tooth-

ache," etc., to be found on the records. The most rapid gain was shown by B. B., a girl, aged 5 years, who increased her weight by one-fifth in four weeks, bringing her from 17.7 per cent underweight to only 1.5 per cent below. She was here in February and March. M. Da., aged 4, shows similar behavior in September. The greatest gain is claimed by A. Go., aged 10, who remained under observation for twenty-three weeks. She was 26.9 per cent below normal when she came and only 7.1 per cent below when she left. During this time she gained more than 35 per cent of her weight on entry. The same



Individual curves showing increase in weight of undernourished children.

child had been studied two years previously in the early phase of the problem, and at that time she was 26.1 per cent below normal, showing very little change during the two years at home.

CONCLUSIONS

This paper is the first of a series of studies on undernourished children. Subsequent papers will deal with energy and food metabolism, involving the chemical analysis of foods and excretions, so that at present we make no allusion to data bearing on this side of the problem.

The data presented show the possibility of profound influence of racial and environmental factors, as well as bad food habits on malnu-

trition. The statement so often made that certain undernourished children cannot gain weight even with proper feeding does not hold true in our estimation. However, we do admit that more care was given these children than the average mother is willing, or in some cases, able, to provide, and we cannot offer an easy formula guaranteed to apply to every case. With reasonable attention to the problem, however, malnutrition need not be terrible bogy that it often becomes through wrong treatment.

The next series of studies will consider types of treatment of undernourished children, and we hope to be able to make some attempt at classification of cases which will aid in clinical treatment.

RÔLE OF THE DYSENTERY BACILLUS IN ARTHRITIS DEFORMANS (TYPE I)

A PRELIMINARY REPORT OF SEVEN CASES, WITH A NOTE ON THE INTRADERMAL REACTION IN DYSENTERY *

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This preliminary communication presents the possibility that some cases of arthritis deformans (type I) may be protean manifestations of an unrecognized infection with a bacillus of dysentery. Four of the seven cases of idiopathic arthritis to be reported were found to have evidence either of an active or of a past infection with a dysentery bacillus.

Jones and Lovett [1] have gathered all of the nontuberculous and non-rheumatic arthritides of unknown etiology into one group called "arthritis deformans," this term being used synonymously with chronic nontuberculous arthritis, rheumatoid gout, osteo-arthritis, rheumatoid arthritis, chronic rheumatic arthritis, chronic rheumatism, and infectious or toxic arthritis. This large group of arthritis deformans is itself divided into two widely separated types of arthritis; the first division being synonymously called type I, or proliferative (referring to the synovial membrane) or atrophic (referring to the bony changes); the second division is called type II, or degenerative (referring to the soft tissue), or hypertrophic arthritis deformans (referring to the exostoses). Type I arthritis deformans occurs in childhood and in early adult life; in childhood it is frequently called "Still's disease."

SPONTANEOUS ATTACK OF DYSENTERY IN "STILL'S DISEASE" TRANSMITTED TO THREE FELLOW PATIENTS

My attention was called to the possible association between arthritis and dysentery when a patient, suffering from Still's disease, developed an acute attack of bacillary dysentery and transmitted it to three fellow patients. These four shared a common ward with sixteen other patients, and all had spent fourteen days in the quarantine ward prior to their admission to the regular ward.

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* From the Department of Pediatrics, Harvard Medical School, and the Bacteriology Laboratory of the Infant's and Children's Hospital.

1. Jones, R., and Lovett, R. W.: Orthopedic Surgery, ed. 1, New York, William Wood & Co., 1923, pp. 247-249.

REPORT OF CASES

CASE 1 (*"Still's Disease"*).—L. B., a boy, aged 5 years, previously in good health, in October, 1922, following a week of malaise, fever and "mushy" stools, refused to use his knees. The finger, knee, ankle, wrist and elbow joints subsequently became swollen and painful without becoming inflamed. A short time later, multiple small painful glands developed on the right side of his neck. He was admitted to the orthopedic service of the Children's Hospital on Jan. 12, 1925, fifteen months after the onset of his trouble, because of the flexion deformities present in almost all of his joints. In addition to the enlarged lymph glands, the spleen was found palpable and the boy was in a very poor nutritional state. Little progress was made during his first nine months in the hospital, and several acute exacerbations during this period seemed to indicate that the cause of the boy's condition was still active. Renewed efforts to discover a cause for these joint symptoms were unsuccessful; no focus of infection could be demonstrated. His general condition had become so alarming that two blood transfusions had been given, with improvement in his general state for a short period, but with no effect on the arthritis.

On September 13, the twenty-third month of the disease, the boy had a gastrointestinal upset, accompanied by malaise and a temperature of 104 F., which returned to normal the following day. Two days later, on September 15, he began to vomit, his temperature rose to 104 F., his joints became more sensitive and he began to pass loose stools containing pus, blood and mucus. The temperature again returned to normal on the following day and the stools became normal within a few days.

Etiologic Studies.—Bacteriologic examination of the blood-streaked stools resulted in the isolation of *Bacillus dysenteriae* of Flexner (table 1 gives details). On October 5, the patient's serum agglutinated his own organism and Dreyer's "standard agglutinable culture" of Flexner "Y" both to a titer of 1:160 (see table 1).

Following this attack of dysentery and subsequent to the disappearance of dysentery bacilli from the stools, the patient's entire clinical condition progressively improved. He gained remarkably in weight, and painless motion in his joints increased, and at the time of writing he was able to walk with assistance. Beginning on October 15, he was given a course of autogenous vaccine; however, the improvement had begun before the vaccine therapy had been instituted.

CASE 2. (*Old Poliomyelitis*).—H. M., a boy, aged 12 years, who had been admitted to the orthopedic ward on Aug. 28, 1925, for a muscle transplanting operation, on September 20 unexpectedly had an elevation of temperature of 104 F. (40 C.) for one day, accompanied by malaise and a watery diarrhea with seven stools daily. The diarrhea lasted for several days, but at no time was there gross blood, pus or mucus in the stools.

Etiologic Studies.—Bacteriologic stool examination, performed because of the association with the preceding patient, isolated *B. dysenteriae* of Flexner (table 1), identical morphologically and culturally with that isolated from case 1, and agglutinated both by this patient's serum (1:80) and by the serum from the first patient (1:160). This patient's serum agglutinated the bacillus isolated from case 1 at a titer of 1:160 (table 1 gives details of this study).

The patient was discharged on October 16, after three negative stools for dysentery bacilli had been recorded. So far as is known, this boy has not developed arthritis.

CASE 3 (*Old Congenital Hip Dislocation*).—L. F., a boy, aged 6 years, who had been admitted to the orthopedic service on August 21, on September 20 developed an unexplained temperature of 103 F. (39.4 C.), which persisted for one day unaccompanied by any constitutional symptoms or diarrhea.

Etiologic Studies.—Again, because of the association with the first patient, stool examinations were made, and a bacillus of the Flexner group was isolated

TABLE 1.—*Laboratory Data*

Case	Clinical Diagnosis	Stool Bacteriology													Patient's Serum													
										Antiserum 1 to 40*					vs. Organism Isolated from				vs. "Standard Agglutinable Cultures"									
																								Flexner-English Types				
		Gram-Negative Nonmotile Bacillus	Dextrose	Maltose	Mannite	Dulcite	Lactose	Saccharose	Xylose	Typhoid	Flexner	Shiga	Hiss "Y"	Poly.-val. Dys.	Case 1	Case 2	Case 3	Case 4	Typhoid	Para "A"	Para "B"	Shiga	"V"	"W"	"X"	"Y"	"Z"	Ct
1 L. B. ♂	Still's disease and dysentery	+	A	A	A	A±	0	0	0	0	0	0	0	+	+ 1-160* 9/30/25	+ 1-160* 9/30/25	0 10/1/25	0 9/30/25	0	0	0	0	0	0	+ 1-40	+ 1-160 20	+ 1-40	0
2 H. M. ♂	Old poliomyelitis and ac. diarrhea	+	A	A	A	A	0	0	0	0	0	0	0	+	+ 1-160* 10/5/25	+ 1-80 10/5/25	0 10/1/25	0 9/30/25	0	0	0	0	0	0	0	0	0	0
3 L. F. ♂	Old congenital hip and day of high temp.	+	A	A	A	A	0	0	A±	0	+	0	0	+	+ 1-40* 10/1/25	0 10/1/25	0 10/1/25	0 10/1/25	0	0	0	0	0	0	0	0	0	0
4 F. D. ♀	Rachitic deformity and ac. diarrhea	+	A	A	A	A	0	0	0	0	..	..	..	+	+ 1-40* 10/21/25	+ 1-40* 10/21/25	0 10/21/25	+ 1-40* 10/21/25	0	0	0	0	0	0	0	0	0	0
5 E. R. ♂	Still's disease	0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0	+ 1/80 15	0	+ 1/40	+ 1/40	0	0
6 J. F. ♂	Inf. arthritis	0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0	0	0	0	+ 1/320 40	0	0
7 M. F. ♀	Multiple arthritis	0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0	0	0	0	+ 1/160	0	+ 1/160	+ 1/320 40	0	0
8 R. C. ♂	Inf. arthritis	0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0	0	0	0	0	0	0	0	0	0
9 E. D. ♂	Inf. arthritis	0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0	0	0	0	0	0	0
10 E. B. ♂	Inf. arthritis	0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0	0	0	0	0	0	0

A indicates acid.

* Agglutination reaction not attempted at a higher titer.

Bold faced figures are agglutination results expressed in "standard agglutination units:" 10 units in the male and 20 in the female are considered diagnostic.

Ct All agglutination reactions were accompanied by saline controls—all of which were negative. The "standard agglutinable cultures" were furnished by Dreyer's laboratory and were used according to his technic.

\+ indicates a positive agglutination with clumping and clearing.

(table 1), which had properties identical with those of the two preceding organisms, and which was agglutinated by both Flexner and polyvalent dysentery antiserums. Directly after it was isolated, this bacillus was not agglutinated by the patient's own serum or by serums obtained from the two preceding patients. This patient's serum agglutinated the bacillus isolated from the first patient at a titer of 1:40.

No untoward sequelae of this infection were observed, the child continuing his previous course undisturbed.

CASE 4 (*Old Rachitic Deformity*).—F. D., a girl, aged 5 years, negro, who was admitted to the hospital on September 4 for the correction of an old rachitic deformity, on September 23 developed a temperature of 105 F. (40.5 C.) accompanied by malaise and a watery diarrhea free from blood. In several days her condition had returned to normal and no arthritic symptoms developed.

Etiologic Studies.—Another gram-negative bacillus was discovered, which possessed the cultural characteristics of the Flexner group, and was agglutinated by both polyvalent dysentery antiserum and by the patient's own serum (1:40). The patient's serum agglutinated the organisms isolated from the first two patients but not the one isolated from the third patient (table 1).

Fig. 1.—A representative pseudodysenterin reaction: this photograph was taken on the second day, at the height of the diffuse reaction. This reaction had completely disappeared by the end of the third day. Negative and positive reactions are indistinguishable before the third day.

THE USE OF THE INTRADERMAL TEST DURING THE BEFOREMENTIONED DYSENTERY OUTBREAK

Following the attack of dysentery in the first patient, an attempt was made to discover the source through which he had acquired the infection. The history of the outbreak did not suggest that the infection had been food borne. That a carrier had started the disease seemed the most likely possibility. This group seemed an ideal one from which to discover if the intradermal injection of dysentery bacilli would be of value in the actual diagnosis of dysentery or in the detection of a carrier. To this end, a formalinized vaccine of the organism isolated in case 1 was prepared, and on September 23 the first patient was given 0.1 cc. intradermally. The next day, there being no untoward reaction, all of the patients and their attendants were given a similar injection; twenty-six injections were made in all, and twenty-four hours later all showed

oval, erythematous, raised, diffuse reactions with irregular margins averaging 3 by 6 cm. in size (figure 1). In every instance, this pseudoreaction had completely disappeared by the end of the third day. The physician in charge of the ward gave the most severe pseudoreaction observed; it appeared within two hours after injection and reached a size of 10 by 15 cm., accompanied by reddening of the lymphatics leading into the axilla and tenderness of the axillary lymph glands, but by the third day all signs of this reaction had completely disappeared.

In patients 1, 2 and 3, as the pseudoreaction disappeared, the site of the original bleb was observed becoming progressively deeper crimson and more indurated, until by the fourth day they possessed red, indurated papules (figure 2) measuring 6 by 8 mm. in case 1, 6 by 6 mm. in case 2, and 3 by 4 mm. in case 3. The fourth patient did not develop an indurated late reaction at this injection, and it will be

Fig. 2.—A representative positive dysenterin reaction: this photograph was taken on the fifth day. The two distal reactions, measuring 5 by 5 mm. and 6 by 7 mm. on the fourth day, were the results of 0.05 and 0.1 cc. injections of the dysentery antigen responsible for the patient's infection. The remains of the negative control injection is just visible, proximally. All three had had similar pseudoreactions, and it was not until the third day that the positive reactions separated themselves from the disappearing negative one.

remembered that the diarrhea had begun only the day preceding her injection. Repeated on September 30, she still gave a negative test to her own organism, but did give an induration of 4 by 4 mm. on the fourth day, as the result of an injection of the bacillus isolated in case 2.

By October 24, all of the patient's stools had become negative for dysentery bacilli, and their intradermal reactions had become either definitely negative or doubtfully positive. Table 2 is the protocol of these observations, in which the complete details, including the control injections and the repetitions of the positive tests, are given.

SEARCH FOR EVIDENCE OF A DYSENTERY INFECTION IN SIX CASES OF IDIOPATHIC ARTHRITIS

CASE 5 (*"Still's Disease"*).—E. D., a boy, aged 2 years, in March, 1925, developed painful, noninflammatory swellings of the wrist, knee and finger joints,

TABLE 2.—*Dysenterin Test Protocol* *

	Source of the Dysentery Antigen Injected	Original Reaction			Test Repeated			Test Repeated			Clinical Data		
		Date of Injection, 1925	Result on Second Day	Result on Fourth Day	Date of Injection	Result on Second Day	Result on Fourth Day	Date of Injection	Result on Second Day	Result on Fourth Day	Date of Diarrhea's Onset	Result of Stool Bacteriology	Date of Third Negative Stool
Case 1 L. B.	Case 1	9/23	1* and 2*	2 6 × 8 mm.	9/28	1 and 2	2 6 × 8 mm.	10/24	1	2± 3 × 4 mm.			
	Case 2	....	.....	.....	9/28	1 and 2	2 6 × 8 mm.	.....	.....	.....			
	Stock Flexner "V"†	9/23	1	—	....	.....	.....	.....	.....	.....	9/15	B. dysenteriae of Flexner	10/17
	Flexner "W"†	9/23	1	—	....	.....	.....	.....	.....	.....			
	Flexner "X"†	9/23	1	2± 3 × 3 mm.	....	.....	.....	.....	.....	.....			
	Flexner "Y"*	9/23	1	—	....	.....	.....	.....	.....	.....			
	Flexner "Z"*	9/23	1	—	....	.....	.....	.....	.....	.....			
Case 2 H. M.	Case 1	9/24	1 6 × 3 cm.	2 6 × 6 mm.	....	.....	.....	.....	.....	.....	9/20	B. dysenteriae of Flexner	10/ 8
	Case 2	....	.....	.....	9/28	1 and 2	2 6 × 8 mm.	10/ 1	1 and 2	2			
Case 3 L. F.	Case 1	9/24	1 and 2	2 4 × 4 mm.	10/1	1 and 2±	2± 3 × 3 mm.	10/24	1	—	9/20 (Temp. of 103 F., no diarrhea)	B. dysenteriae of Flexner	10/20
	Case 2	....	.....	.....	10/1	1 and 2 8 × 10 mm.	2 8 × 10 mm.	.....	.....	.....			
	Case 3	....	.....	.....	10/1	1 and 2	2 6 × 8 mm.	.....	.....	.....			
Case 4 F. D.	Case 1	9/24	1	—	9/30	1	—	10/24	1	2± 3 × 4 mm.			
	Case 2	....	.....	.....	9/30	1	2 5 × 6 mm.	.....	.....	.....			
	Case 3	....	.....	.....	9/30	1	—	10/24	1	2 4 × 4 mm.	9/23	B. dysenteriae of Flexner	
	Flexner "V"†	....	.....	.....	9/30	1	—	.....	.....	.....			
	Flexner "W"†	....	.....	.....	9/30	1	—	.....	.....	.....			
	Flexner "X"†	....	.....	.....	9/30	1	—	.....	.....	.....			
	Flexner "Y"†	....	.....	.....	9/30	1	—	.....	.....	.....			
	Flexner "Z"†	....	.....	.....	9/30	1	—	.....	.....	.....			
The 22 remaining patients and their attendants injected with the bacillus of case 1		9/24	1	—									

* 1, the diffuse pseudoreaction (fig. 1); 2, the indurated positive reaction measuring at least 3 by 4 mm. on the fourth day (fig. 2); 2±, an induration of less than 3 by 4 mm.; —, reaction completely disappeared.

† The Oxford "standard agglutinable culture" used as antigen.

accompanied by a "slight fever." His tonsils were said to be inflamed, and he was given acetylsalicylic acid for his pain and kept in bed for five weeks. In May, his tonsils were removed, and at this time a note from the outpatient department records the heart as being normal. Following the tonsillectomy, his joint symptoms became worse and he was admitted to the Children's Hospital on June 6. No history of the boy ever having had an attack of dysentery or diarrhea could be obtained. He was well developed but much undernourished, constantly whining, and would cry out in terror when one approached to disturb him. He had the set, heavy facies of "Still's disease." The originally involved joints were still swollen and painful, and in addition the ankles had become involved. His lymph glands were enlarged and his spleen was palpable. Physical findings of pericarditis were found, but the heart sounds themselves were found to be normal, although distant. The pericarditis disappeared during the patient's first week in the hospital, and the heart subsequently seemed normal. In spite of thorough studies carried on over a period from his admission in June to October, no etiology for his condition could be found; particular attention to possible foci of infection disclosed nothing abnormal. In spite of everything that could be done for this child, his condition became progressively worse.

Etiologic Studies.—Because of the apparently spontaneous occurrence of dysentery in the first patient in my series (who also had Still's disease); because the literature had shown that arthritis following recognized bacillary dysentery was a well established clinical entity (to be described later), and because the findings in cases 2, 3 and 4 had demonstrated that a true dysentery infection may occur without producing recognizable symptoms, I had decided to search for evidence of dysentery infection in those patients with arthritis that I might study in the future. In the present case, agglutination reactions were attempted in October between the patient's serum and an extensive series of dysentery antigens (table 1), and agglutinins were found active against *B. dysenteriae* Flexner, English type "V," to a titer of 1:80 or to 15 "standard agglutination units." (The Dreyer's cultures used are so standardized that 10 "units" are considered diagnostic.) Four cubic centimeters of thick, greenish fluid was aspirated from the right knee joint and was also found to contain agglutinins against Flexner "V" to 1:80. No dysentery organisms were recovered from the stools or joint fluid.

Following this observation, which was repeatedly confirmed, vaccine therapy, using this particular strain of Flexner organism, was obviously indicated and instituted. One week after vaccine therapy was begun, there was a universal erythema accompanied by a temperature of 105 F. (40.5 C.). The erythema disappeared in twenty-four hours, and was followed by a temporary reduction in and flattening of the oscillating temperature curve. Coincidentally, the joints became less sensitive but were still as swollen as before and the child began to improve clinically. This clinical improvement without any reduction in the joint swellings has continued over two months; as yet, no deformities have developed and the joints are being used voluntarily without pain. As it is impossible to say whether the vaccine had anything to do with this improvement, or whether it was just the natural course of the disease, no conclusions can be drawn.

Miscellaneous Data.—June 13, red blood cells, 4,800,000; white blood cells, 17,000, with 78 per cent polymorphonuclears and 19 per cent lymphocytes. December 11, white blood cells, 24,500, with 76 per cent polymorphonuclears and 17 per cent lymphocytes.

CASE 6 (*"Infectious Arthritis"*).—J. F., a boy, aged 7 years, in November, 1924, had marked diarrhea unaccompanied by blood, pus or mucus, lasting for three weeks. In September, 1925, he experienced a pain in the left knee joint, which soon caused him to walk with a limp. The knee became swollen and tender but did not become inflamed. During the next week, the left ankle became swollen and painful. The tonsils were removed in October without affecting the arthritis. When seen in the outpatient department of the Children's Hospital on Nov 11, 1925,

he had been having a mild attack of blood-free diarrhea, with five stools a day. He entered the hospital on November 20, with the swelling and pain in the left knee and ankle still present. The left knee was slightly stiff and held in flexion.

Etiologic Studies.—Agglutinins were demonstrated in the blood serum active against *B. dysenteriae* Flexner "Y" to a titer of 1:320, or to 40 "standard agglutination units" (10 being considered diagnostic). No suspicious organisms were recovered from the stools (table 1).

The boy made an uneventful recovery and was discharged on December 12. On Jan. 15, 1926, a note from the outpatient department stated that he was walking without a limp and, except for an occasional pain in the left knee, had completely recovered.

CASE 7 (*"Multiple Arthritis"*).—M. F., a girl, aged 16 months, in 1921, had fallen off a chair and subsequently was noticed to have a swollen left ankle which was not painful or inflamed. Three weeks later the right ankle became swollen, red and painful, and the child had chills and fever. The left elbow joint next became "thick and swollen." Following the acute process, her joints were left with severe flexion deformities. Many attempts to correct these deformities had been made, and it was for this purpose that she was admitted to the orthopedic ward of the Children's Hospital on Sept. 15, 1925. While under treatment the last time, she had an acute exacerbation of the joint symptoms suggesting that the cause of the arthritis was still present.

Etiologic Studies.—The blood serum contained agglutinins active against *B. dysenteriae* Flexner "Y" to a titer of 1:320 or to 40 "standard agglutination units" (20 "units" being considered diagnostic in the female). The stool examinations were negative (table 1).

As a result of the agglutination findings, the patient was given Flexner's "Y" vaccine, and Dr. Robert B. Osgood permits me to report "much improvement from vaccine."

CASE 8 (E. D.), CASE 9 (R. C.), and CASE 10 (E. B.).—These three patients were suffering from arthritis deformans (type 1), and in them complete agglutination studies were made (table 1) without discovering any evidence of dysentery.

THE ARTHRITIS THAT FOLLOWS RECOGNIZED DYSENTERY

The first description of the arthritis following a definite clinical attack of dysentery is credited [2] to Sydenham in 1672, following the dysentery epidemics of 1668-1672 in England. In 1917, Whitmore [3] summarized Stettner's [4] report of thirty cases of arthritis following bacillary dysentery. Graham,[5] before presenting his series of thirty-three cases of arthritis following bacillary dysentery observed by him in Mesopotamia, gives references to the literature on this subject, mentioning Beveridge's report of five cases of arthritis following 147 cases of dysentery seen by him in South Africa, Cowan and Miller's seven

2. Garrison, F. H.: History of Medicine, ed. 3, Philadelphia, W. B. Saunders Company, 1922, pp. 271 and 311.

3. Whitmore, E. R.: Nelson's Loose-Leaf Medicine, New York, Thos. Nelson & Sons **2**:169 H and 169 I, 1923.

4. Stettner, E., quoted by Whitmore, E. R.: Gelenkrheumatismus und Ruhr, München. med. Wchnschr. **64**:854, 1917.

5. Graham, G.: Arthritis in Dysentery. Causation, Prognosis and Treatment, Proc. Roy. Soc. Med., Section of Medicine **13**:23-42, 1919-1920.

cases, Waller's six cases, Klein's five cases, and additional cases reported by Garrod, Rist, Crouzon and Moreau. No specific references to arthritis following dysentery in children were encountered.

Graham found that the onset of the joint symptoms was from six to twenty-three days after the first symptoms of dysentery, although he mentions one case in which the arthritis and dysentery began simultaneously. Stettner gave the onset of arthritis as from three to four weeks after the cessation of the dysenteric symptoms. The onset of these arthritides was heralded by severe joint pain "preceding the swelling by some hours" and often "accompanied by slight fever, which recurred as each joint became involved." "There was no reddening of the skin and the joint was not hot—even in the most acute cases. In some cases, many joints were affected on the same day, but in most of the cases the joints were attacked at intervals. In one case four joints were affected in the course of ten days."

The knee joint was the one most commonly involved: "both in sixteen cases and one in fifteen" (of thirty-three cases). Stettner [4] found the knee always involved, the ankles and toes next, while the hip was but rarely involved. In the upper extremity he considered the elbow and shoulder the most commonly involved, while the wrists and fingers were rarely involved. Graham found the ankles and elbows followed the knee in order of frequency, and then came the small joints of the wrists with the sternoclavicular and temporomandibular rarely involved. "The severe pain went away long before the joint swelling subsided." Graham found no relation between the severity of the dysentery and the severity of the arthritis, the tendency being rather that the mild infections produced the most severe arthritides.

Arthritis, conjunctivitis and urethritis may occur in the same case. Stettner (out of thirty cases) found conjunctivitis in fifteen, purulent urethritis in nine and cardiac involvement in ten. Osler [6] states that severe cases of bacillary dysentery may be complicated by "pleurisy, thrombosis, pericarditis, endocarditis and occasionally by pyemic manifestations."

In the arthritides due to or associated with dysentery, the joint fluid may be clear or slightly cloudy, and contain a number of pus cells. "It is usually sterile, though Elsworthy cultivated the Shiga-Kruse bacillus from the joint fluid." [3] Whitmore mentions that "Tscherning obtained the Y bacillus (of Flexner) from a chronically inflamed gallbladder at operation, in a patient who had had bacillary dysentery three years before." Kostrzewski [7] found 33 per cent positive blood cultures in

6. Osler, W., and McCrae, T.: The Principles and Practice of Medicine, ed. 9, New York, D. Appleton & Co., 1922, p. 130.

7. Kostrzewski, J., referred to by Whitmore, E. R.: Bakteriologische Blutuntersuchungen bei Dysenteriekranken, Przegl. epidemjol. **1**:466, 1921.

115 cases of Shiga-Kruse dysentery, and Boyd [8] found Flexner's "Y" in the blood stream, although the general impression is that dysentery bacilli are not supposed to invade the blood stream.

The temperature in Graham's series, after the acute rise had subsided, oscillated from 99 to 100 and 102 F. at night. In the severe cases, the temperature continued in this manner for many weeks. Nothing except the joint lesions could be found to explain the pyrexia. Twenty of his thirty-three cases had this long continued pyrexia. Of his patients, seven were well within four weeks, while twenty were ill for much longer periods, and at the time his paper was written he said that he could not predict what their ultimate outcome would be. He observed that there was a tendency to stiffening in these joints. One of his patients was unable to walk for six months, and at the end of that time was barely able to use his hands well enough to write a letter.

In Graham's series, twelve cases followed dysentery of the Shiga type, and four followed the dysentery of Flexner. Twelve cases gave a typical history of dysentery with bloody stools, but the type of dysentery had, for various reasons, not been determined. Three of his patients are of particular interest in the present connection, for they entered complaining of arthritis, without having a history recognizable as dysentery, but were later found to have dysentery agglutinins in their blood serums.

COMMENT

The small outbreak of dysentery in the isolated colony of the orthopedic ward furnishes a number of significant observations. The only plausible explanation for the outbreak is that it was started by a carrier, and that that carrier was patient 1 (case 1, "Still's disease"). This patient, possibly, had been harboring dysentery bacilli in some unknown focus until the lowering of his general resistance, augmented by those unknown factors that caused "summer diarrhea" to be then prevalent, produced conditions favorable for the development of dysentery. The three patients infected with this common organism demonstrate its low virulence, and show that it is possible to have a dysentery bacillus infection without its producing symptoms even suggesting dysentery.

In four of the seven cases of idiopathic arthritis studied, evidence of a dysentery bacillus infection was found. Two of the four patients had had definite diarrhea, one of these being of the bloodstained, mucoid type. Two gave no history of ever having had diarrhea. A dysentery bacillus of the Flexner type was isolated from the stools of one. All

8. Boyd, J. S. K.: A Case of Bacillary Dysentery in which Flexner Y was Recovered from the Blood Stream During Life, Lancet **2**:482, 1919.

four possessed dysentery agglutinins in the blood serum and one in the joint fluid, to a point well above that considered diagnostic for the "standard agglutinable cultures" of Dreyer that were used. It is of interest that pericarditis, given as one of the complications of dysentery, was present on admission in one of these patients.

Arthritis deformans (type I) bears a striking resemblance to the arthritis reported in the literature as following bacillary dysentery. Graham mentions that, were it not for its occurrence in his cases during a dysentery epidemic, he would have diagnosed them as "rheumatoid arthritis." In connection with the possible relationship between dysentery and arthritis deformans, the reported cases of the recovery of dysentery bacilli from the blood stream and joint fluid, and especially the reported case in which dysentery bacilli were isolated from the gallbladder three years after the original dysentery infection, are of particular interest. The variety of complications and sequelae following dysentery seems difficult to explain, unless we assume that the bacilli may cause bacteriemia and thus give the opportunity for the establishment of distant foci. Without a blood stream invasion, we have the possibility that a focus may be set up in the intestinal tract itself. Soper,[9] out of 411 unselected cases of proved gallbladder disease, found thirty-eight with a definite relationship to typhoid fever and seventeen definitely related to dysentery. If gallbladder localization following dysentery proves to be analogous to that following typhoid fever, we have an ideal site from which toxin might be disseminated without the production of intestinal symptoms. Flexner and others have shown that many of the "summer diarrheas" are caused by *B. dysenteriae* of Flexner. I found Flexner bacilli accounting for many of the "summer diarrheas," free from blood, last summer, and it is probably true that dysentery bacilli of the Flexner type are more common inhabitants of the temperate zone than is fully appreciated. If the preceding statement is true and dysentery infection may occur without producing a clinical picture suggesting dysentery, and if a small percentage of dysentery will be complicated by arthritis, then, in studying idiopathic arthritis, the possibility of an unrecognized dysentery infection as its etiology should be considered.

The usual methods of diagnosing acute bacillary dysentery are equally applicable to the study of these arthritides. Davison [10] gives an excellent description of the methods of diagnosing bacillary dysentery. Since it will be through agglutination reactions that the etiology of these arthritides will be best approached, the importance of using an extensive

9. Soper, H. W.: Relationship Between Disease of the Gallbladder and Infection in the Gastro-Intestinal Tract, Ann. Clin. Med. **4**:422 (Nov.) 1925.

10. Davison, W. C.: A Bacteriological and Clinical Consideration of Bacillary Dysentery in Adults and Children, Medicine **1**:3, 414-416 (Nov.) 1922.

antigen series cannot be overemphasized. There being at least five serologic types of Flexner dysentery bacilli, it is evident that unless they are all included in the agglutination antigens, a true infection with a strain not included may be overlooked and false conclusions reached. All of the agglutination reactions in the cases reported in this communication were performed using Dreyer's "standard agglutinable cultures" according to his technic; these antigens were obtained from the Pathology Department of the University of Oxford.

Under the conditions found in the orthopedic ward, in which all the patients with diarrhea were demonstrated to have been infected by a common organism, the series of intradermal tests, using this common organism as antigen, produced consistent results. All of the patients and attendants gave a pseudoreaction that completely disappeared by the fourth day. In those patients from whom dysentery bacilli were isolated, by the fourth day after the intradermal injection there was present what was interpreted as a positive reaction. This reaction was a red, indurated papule measuring at least 4 by 4 mm. on the fourth day after the injection. Too little is known of these reactions for them to be of any diagnostic importance as yet, but it would seem that they should be of practical value in the detection of carriers during an individual epidemic. The test appears to develop early, and becomes negative soon after the disappearance of the organism from the stool.

CONCLUSIONS

1. That the symptom complex called arthritis deformans of type I may, in some cases, be the arthritis following an unrecognized dysentery bacillus infection, is the possibility raised by the observations here reported. Seven cases of arthritis deformans are reported, in four of which there was evidence of there having been either an active or a past infection with *B. dysenteriae* of Flexner.

2. The literature shows arthritis following a typical dysentery to be a well established clinical entity that may occur as long as four weeks after the acute attack.

3. It is possible to have a dysentery bacillus infection without its producing a clinical syndrome recognizable as dysentery.

4. Dysentery should be considered as an etiologic factor in arthritis deformans (type I), and only ruled out after bacteriologic studies and agglutination reactions, using a complete series of antigens, prove to be negative.

5. Under the exceptional conditions governing these observations, the dysenterin reaction proved to be a specific diagnostic test. It has not been studied on a large enough scale to permit any general conclusions as to its value.

COR BIATRIA TRILOCULARE WITH TRANSPOSITION OF ARTERIES

CASE REPORT WITH NECROPSY FINDINGS *

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The case reported here is that of an interesting cardiac anomaly in a child who lived two and one-half years without showing marked symptoms until two weeks before death. The colored skin of the patient, a negro child, made it difficult to recognize cyanosis. No infectious lesion was demonstrable as the cause of death. An unusual arrangement of the mitral valve adds interest in explaining the physiologic functioning of this heart. The patient was admitted to the pediatric service of the Louisville City Hospital.

REPORT OF CASE

History.—J. M., a boy, aged 2½, was born at full term, of normal delivery, and weighed 9 pounds. There had been no prenatal care. The parents were in good health. The father had two sisters who died of tuberculosis. The mother gave no history of miscarriages. The attending physician at the time of delivery told her the baby had a weak heart. The child sat up at 3½ months; teeth first appeared at 8 months, and he was weaned at 1 year of age. He talked at 18 months, and walked at 27 months. He was healthy, and had none of the diseases of childhood.

Present Illness.—Fourteen days previous to death, the abdomen became distended with edema of the wall. Edema of the feet and hands was noted the following day. The third day the edema became generalized, and rather marked in the face. The stools were regular, soft and yellowish. The mother thought the child had pain in the abdomen because of crying and flexion of the thighs. He was admitted to the Louisville City Hospital eight days after the onset of illness.

Physical Examination.—The patient was well-developed and well-nourished male negro child. A generalized edema was present, which gave the face a distorted appearance. The head was relatively much overdeveloped in size, being 19½ inches in circumference. His height was 32 inches. The skin was hot and dry and the veins of scalp appeared distended. The fontanels were closed. The eyelids were edematous. There was no nasal discharge. The ears were normal. The mucous membrane of the mouth showed no color change. The tonsils were somewhat enlarged but otherwise normal. There were palpable lymph glands in all triangles of neck. The thorax was symmetrical and normal in shape. The respiratory movements were irregular and difficult, 36 per minute and costo-abdominal in type. No râles could be heard but there was a harshness of breath sounds posteriorly at the base. The apex beat of the heart was not visible; it could be palpated in the sixth interspace 15 mm. external to the left nipple line. The cardiac dulness extended 4 cm. left of the midsternal and 2 cm. to the right in the second intercostal space. In the sixth intercostal space it extended 10 cm.

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to the left of the midsternal line. The heart sounds were heard plainly and no murmurs were present. There was no pericardial rub. The pulse rate was 120 per minute. The abdomen was distended, round and fluctuant, and there was no rigidity of the muscles. The viscera could not be palpated. The percussion note was dull to flat and changed with posture. The extremities were normal in appearance; there was no clubbing of the fingers.

Laboratory Examination.—White blood count, 8,000 per cubic millimeter; red blood count, 6,200,000 per cubic millimeter; polymorphonuclear neutrophils, 62 per cent; small lymphocytes, 30 per cent; large lymphocytes, 6 per cent; basophils, 1 per cent; transitionals, 1 per cent. Repeated urine examinations showed albumin plus; negative for sugar; straw colored, acid, and with a specific gravity of 1.016. Microscopic examination showed a few red blood cells and many uric acid crystals. Roentgenologic examination showed a greatly enlarged cardiac shadow with no evidence of pulsations. Roentgen-ray diagnosis was massive effusion in the pericardium.

The clinical diagnosis of pericarditis with effusion and the possibility of nephritis, was made. The patient was in the hospital for five days. Temperature, per rectum, on admission was 98.8 F. On the second day it rose to 100.8. It was normal the following day and the remainder of the time in the hospital. On the second day after admission, a pericardial paracentesis was attempted, but no fluid was obtained except for about 5 cc. of blood. Therapy consisted of digitalis and compound jalap powder. The condition of the patient varied slightly the entire time on the ward; labored breathing was present continually. The afternoon of the fifth day, following very difficult breathing, the patient ceased to breathe.

NECROPSY REPORT

Necropsy was performed two hours after death. The body is that of a well developed, well nourished negro child, male, measuring 80 cm. in length. The head and face appear swollen and body pits everywhere on pressure. The skin is dry and wrinkled. Rigor mortis is slight. The hair is normal, black and kinky. Pupils are equal, 3 mm. in diameter. The teeth are normal; the lips are dry, parched and slightly fissured with a brownish coating.

Peritoneal Cavity.—The fat of the anterior abdominal wall is 3 cm. thick. Subcutaneous tissue shows accumulations of fluid as evidenced by gelatinous deposits, from which can be expressed serous fluid. The cavity contains about 1,500 cc. of amber tinted, serous fluid. The gallbladder and transverse colon are adherent with what appears to be a congenital adhesion. The foramen of Winslow is patent. The lower liver margin is 4 cm. below the tip of the xiphoid in the midsternal line, 2 cm. below the costal border in the right midclavicular line. The peritoneum is smooth and clean.

Pleural Cavity.—Each contains about 400 cc. of serous fluid. There are no adhesions. The thymus extends down over the pericardium in a normal manner and is somewhat lobulated. It measures 50 by 35 by 20 mm. There is an extravasation of blood over the anterior surface and the left side of the pericardial sac. This blood clot lies in the wall of the pericardium. The left border of the pericardium is 8 cm. at left of the midsternal line in the sixth interspace. The right border is 6 cm. at the right of the midsternal line in the third interspace.

Pericardial Cavity.—On opening the cavity no free blood is found. About the normal amount (30 cc.) of light straw tinted, serous fluid is noted.

Heart.—This organ is greatly hypertrophied and distended, somewhat oval in appearance. On the anterior surface of the left ventricle are four punctate abra-

sions, probably the result of attempts at pericardial paracentesis. There is no blood clot on these areas. The organ is opened in situ. The right auricle contains considerable blood clot and has normal openings and architecture. The foramen ovale is closed. The tricuspid valve is normal in appearance. The chordae tendineae of the middle posterior leaflet is attached to a noticeably hypertrophied group of papillary muscles arising from extreme lower left area of the right ventricle. Further examination of the right ventricle reveals absence of the interventricular septum. The hypertrophied group of papillary muscles attached to the middle leaflet of the tricuspid valve are at the normal position of the base of the interventricular septum. They form a partial obstruction between the two ventricles, but leave considerable space between it and the anterior and posterior heart wall. The largest opening is oval, 45 mm. in greatest diameter, and is that space corresponding to the pars membranacea, but due to the absence of the septum, is considerably larger. The space between the papillary muscles

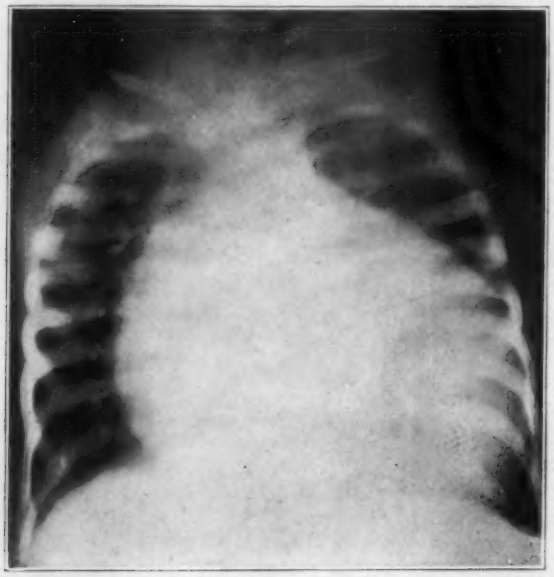

Fig. 1.—Roentgenogram of chest, showing enormous hypertrophy of heart.

referred to and the anterior heart wall is somewhat irregular in outline and measures 25 mm. in greatest diameter. There are smaller openings between these muscles which will easily let blood flow through them. There is a cushion of muscle 6 mm. thick at the site of the upper rim of the normal position of the interventricular septum, which is smooth and covered with endocardium. This forms the upper margin of the spacious opening between the ventricles. The pulmonary valve leaflets appear normal. The left pulmonary sinus of Valsalva has two arteries arising from it, 3 mm. and 2 mm. in diameter at their orifices. The smallest, which is on the right, takes a course to the left of the pulmonary artery, turns forward and branches over the anterior middle portion of the ventricular surface of the heart. The left and largest passes between the pulmonary artery and left auricular appendix, and continues as the left coronary does normally. Another artery, 3 mm. in diameter at its orifice, arises from the middle pulmonary sinus of Valsalva and takes the course that the right coronary artery does normally. On opening the pulmonary artery it is found to continue as the aorta, and gives off the branches common to the aortic arch in their

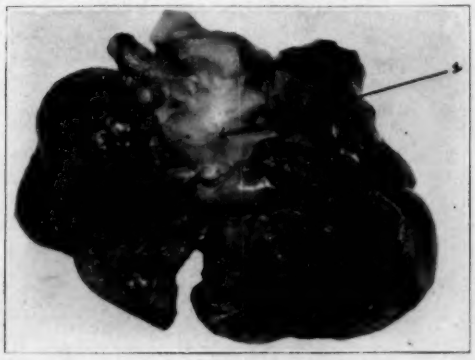

Fig. 2.—A view of the right ventricle, pulmonary valve (1), pulmonary artery continuous as aorta.

Fig. 3.—The right side of the heart showing the spacious opening between the two ventricles due to the absence of the septum and only obstructed by (2) the hypertrophied papillary muscle. (1) The cushion of muscle at location of pars membranacea.

normal relations. There is a barely noticeable ridge in the endocardium which encircles the artery at the junction of the transverse and descending limbs of the arch of the aorta. No evidence of a ductus arteriosus can be found. The left auricle is relatively smaller than the right, and presents some abnormal openings of interest. Only two pulmonary veins empty into the auricle and each measures 10 mm. in diameter. Dissection of these veins prove they arise from the lungs with no communication with a large vessel. At the left, inferior, posterior portion of the left auricle are three abnormal openings 3, 3 and 2 mm. in diameter, from which three arteries take their origin. These arteries ramify over the posterior and left ventricular surface of the heart. They apparently anastomose with the largest coronary artery arising from the left pulmonary sinus of Valsalva. The left auriculoventricular valve presents an interesting structure. It is normal in thickness and bicuspid in form. The right cusp is large and broad, 25 by 22 mm. This cusp has an anomalous insertion of its chordae tendineae. It is attached to the group of hypertrophied papillary muscles already described as forming the obstruction between the two ventricular cavities. The base of this mitral leaflet is normal. Because of this anomalous insertion of its chordae tendineae, the leaflet forms a curtain over the aortic opening when viewed from the left ventricle. The left ventricle is relatively smaller in capacity than the right. The aortic opening is at its normal location and has normal leaflets. There are no arteries arising from the aortic sinuses of Valsalva. On opening the aorta it is found to continue to the hilum of the lungs, terminating in the lung substance. This artery does not communicate with any large vessel.

Lungs.—These are removed with heart. The shape and appearance are normal. They are dull pinkish gray with slight bluish-gray mottling. Crepitation is slightly diminished. The cut surface is pinkish gray and some free fluid is obtained on scraping. The spleen weighs 60 Gm.; the liver weighs 460 Gm.; the left kidney weighs 60 Gm.; the right, 55 Gm. The pancreas, gastro-intestinal tract, suprarenals, bladder and genital organs are normal.

Bacteriology.—Culture of the heart's blood in dextrose broth gives no growth after five days. The Wassermann examination is negative.

Anatomic Diagnoses (gross and microscopic).—Transposition of aorta and pulmonary artery; absence of interventricular septum (cor biatria triloculare); anomalous insertion of chordae tendineae of right leaflet of mitral valve; anomalous origin of coronary arteries; cardiac hypertrophy; generalized anasarca; ascites; hydrothorax, bilateral; passive congestion of spleen, liver and kidneys; congenital adhesion of gallbladder and transverse colon; extravasation of blood in wall of pericardial sac; recent puncture wounds of heart.

CRANIOPHARYNGEAL POUCH CYST ARISING FROM THE PITUITARY BODY: OPERATION WITH RECOVERY *

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Cysts of the pituitary body have been recognized since Erdheim's [1] studies of their cellular construction, but they have only been attacked in a surgical way during the past few years. Cushing,[2] Jackson,[3] and Lewis [4] have perfected the operative technic for removing these cysts. They are of two types, the one originating from the hypothysial duct and the other from Rathke's [5] pouch—a diverticulum of the embryonic buccal cavity from which the anterior lobe of the pituitary body develops. The latter are considered to be rudiments of embryonic development, in which the primary oral ectoderm has become misplaced. As the bones at the base of the skull develop, the attenuated oral end of this pouch atrophies, and the distal end becomes completely severed from the buccal end. They are called craniopharyngeal pouch cysts, extending upward and forward above the pituitary body, but beneath the optic chiasm.

Histologically, these pouch cysts differ from duct cysts in that the former are composed of stratified cylindric epithelium, while the latter are composed of modified squamous epithelium which gradually passes over into the cubical epithelium (Luschka,[6] von Milhalkovics [7]). This difference should be kept in mind when tissue has been removed from cysts in this region.

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* Received for publication, April 15, 1926.

1. Erdheim, J.: Zur normalen und pathologischen Histologie der Glandula thyreoidea, parathyreoidea und Hypophysis, Beitr. z. path. Anat. u. z. allg. Pathol. **33**:158, 1903; Ueber Hypophysenganggeschwulste und Hirncholesteatome, Sitzungsb. d. k. Akad. d. Wissensch. Math.-naturw. Clin., Wien. **113**:537, 1904; Ueber einen neuen Fall von Hypophysenganggeschwulst, Centralbl. f. allg. Path. u. path. Anat. **17**:209, 1906.

2. Cushing, H. W.: Surgical Experiences with Pituitary Disorders, J. A. M. A. **63**:1515 (Oct. 31) 1914; Notes on a Series of Intracranial Tumors and Conditions Simulating Them, Arch. Neurol. & Psychiat. **10**:6 (Dec.) 1923; Les syndromes hypophysaires au point de vue chirurgical, Rev. neurol. **38**, June, 1922.

3. Jackson, H.: Craniopharyngeal Duct Tumors, J. A. M. A. **66**:10-82 (April 8) 1916.

4. Lewis, D. D.: A Contribution to the Subject of Tumors of the Hypophysis, J. A. M. A. **55**:1002 (Sept. 17) 1910.

5. Rathke, H.: Ueber die Entstehung der Glandula pituitaria, Arch. f. Anat., Physiol. u. wissensch. Med. **5**:482, 1838.

6. Luschka, H.: Der Hirnanhang und die Steissdruse des Menschen, Berlin, 1860.

7. Von Milhalkovics, V.: Wirbelsaite und Hirnanhang, Arch. f. Midrosk. Anat. u. Entw. **11**:389, 1875.

REPORT OF CASE

History.—L. T., a girl, aged 3½ years, was the sixth child, of Hungarian parentage, whose sisters and brothers are all well and of normal height and development; the seventh child is perfectly normal. Both parents are living and well. There is no history of tuberculosis, cancer or syphilis. The patient was born at full term and was of normal size. She was breast fed for four to five months with supplementary feedings, and did well on a formula. She cut teeth, sat up, walked and talked at the usual time. She had otitis media about one year prior to examination, which was followed by a discharge from her ear of short duration. There were no other illnesses, and the child showed no abnormality until May, 1925, when the present illness began.

Fig. 1.—Child before operation.

Symptoms.—The child began to lose weight rapidly, losing in all about 18 pounds (8.2 Kg.). On account of her failing appetite and marked weight loss, attempts were made to force food with consequent vomiting. In June, she began to change gradually from a fairly bright child to one apathetic, irritable, drowsy and inattentive. She was always thirsty, constantly asking for water or something to drink and passed large quantities of urine. In July, she began to complain of constant supra-orbital pain.

Examination.—When I first saw the child, in October, she was very thin, anemic, malnourished, and emaciated. Her skin was fine in texture, dry, and somewhat olive tinted; her hair was very thin, dry, and of dead appearance. The optic nerve findings were not possible to determine. The fundi disks were sharply outlined, of normal size and pale, and the veins were slightly dilated. The pupils

were equal, regular, and reacted to light. The muscle movements were normal. There was no nystagmus, exophthalmos or choked disk.

Roentgen-ray examination showed that the sella seemed unusually large for a child of 3½ years, and showed shadows within the fossa, which, with some calcareous masses, extended upward and backward from the tip of the posterior clinoids. These findings suggested brain tumor.

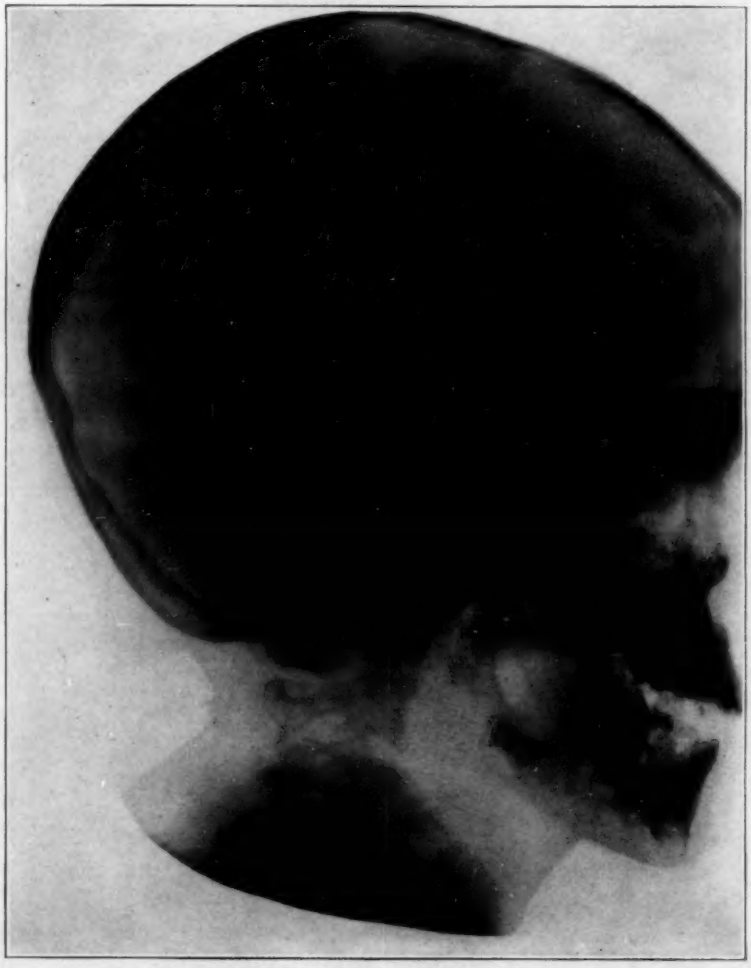

Fig. 2.—Roentgenogram of skull before operation.

Spinal fluid examination revealed 2 cells per centimeter; globulin, negative; reducing substance, trace; Wassermann reaction, negative.

Blood count showed red blood cells, 4,500,000; white blood cells, 13,000; hemoglobin, 70 per cent; large lymphocytes, 66 per cent; polymorphonuclears, 20 per cent; eosinophils, 12 per cent; basophils, 2 per cent. No change was noted in the red blood cells.

The urine was clear, pale and negative for sugar and albumin. The specific gravity was 1,000, and the microscopical examination was negative. The reaction was alkaline.

The chief findings were: Loss of appetite and weight; vomiting; apathy; polydipsia; polyuria; headache. The fundi showed optic atrophy, with probable bitemporal hemianopsia. By roentgenogram, calcareous masses, probably a cyst, were seen occupying the fossa.

COMMENT

The study of diabetes insipidus was inaugurated in 1849, with the well known animal experiments conducted by Claude Bernard,[8] who

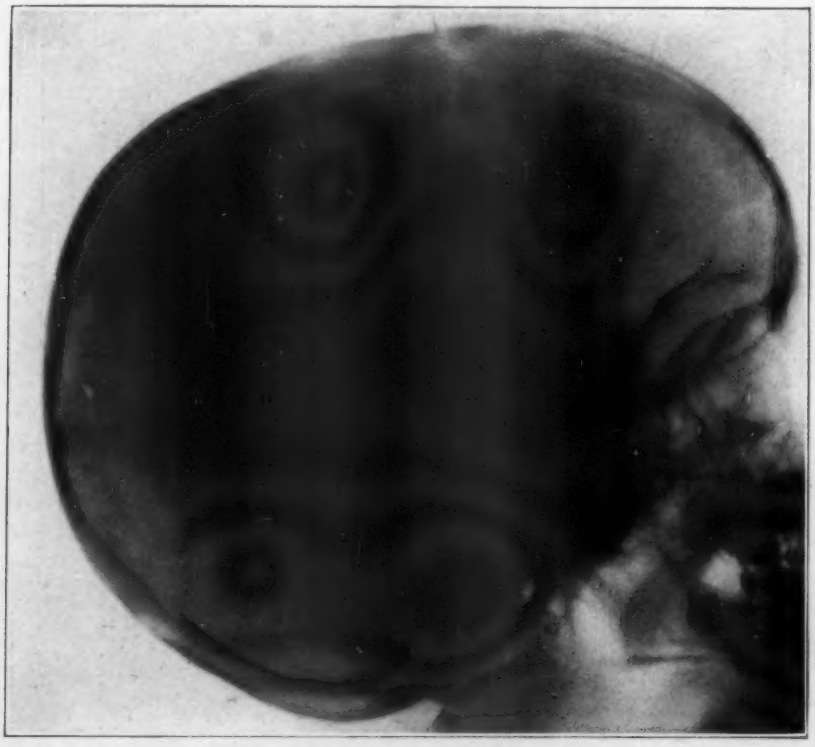

Fig. 3.—Roentgenogram of skull after operation.

found that injury to a certain point in the floor of the fourth ventricle just above the so-called "diabetic center" produced transitory simple polyuria. Kahler[9] was able to produce permanent polyuria, accompanied by polydipsia in rabbits, the condition resembling diabetes insipidus in man. He accomplished this by injecting minute quantities

8. Bernard, Claude: Leçons sur les proprietes physiologique et les alterations pathologiques des liquides de l'organism, Paris, 1859.

9. Kahler: Die dauernde Polyuria als cerebrales Herdsymptom, Prager Vierteljahrschrift, Prag. Leipz., 7, 1886.

of concentrated silver nitrate solution into various parts of the brain. In 1897, Ralfe [10] pointed out the effect of remote lesions of the nervous system on urinary secretion. The discovery by Schafer and Magmus [11] of the diuretic effect of extract of the posterior lobe of the pituitary gland, and the observations by Schafer and Herring,[12] that the renal arteries are exempt from the constricting effect exercised by this extract on other vascular channels, and on unstriped muscles in general, was

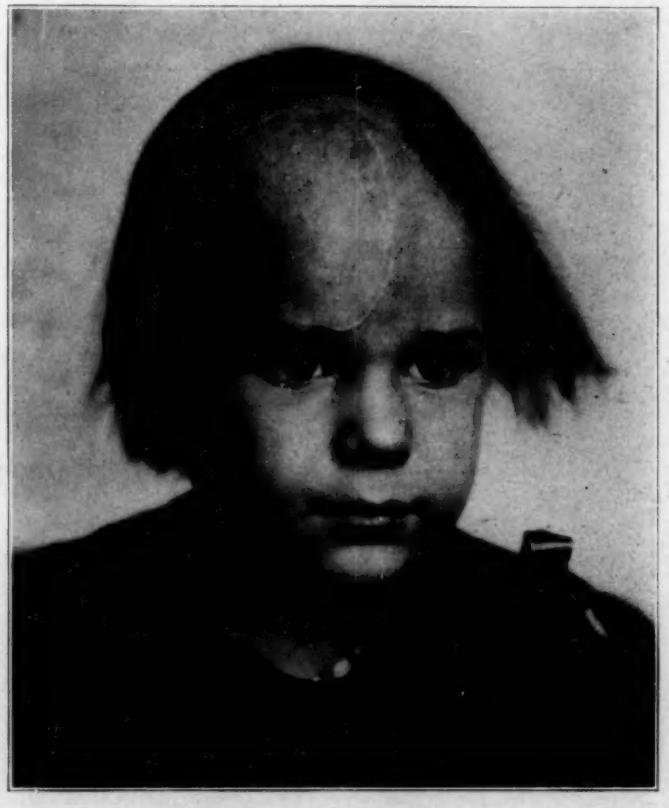

Fig. 4.—Appearance of healed scar.

important evidence leading to the associating of diabetes insipidus with hypopthysis cerebri. Frank [13] believed that many cases of diabetes

10. Ralfe, C. H.: Diabetes Insipidus, Albutt's System of Medicine, Ed. 2, 1907, p. 212.

11. Schafer and Magmus: The Action of Pituitary Extract Upon the Kidney, J. Physiol. **27**:9, 1901.

12. Schafer and Herring: The Action of Pituitary Extracts Upon the Kidney, Philosoph. Tr. Roy. Soc., London **199**:1, 1906.

13. Frank, E.: Ueber Beziehungen der Hypophyse qum Diabetes Insipidus, Berl. klin. Wchnschr. **49**:393, 1912.

insipidus resulted from hypersecretion of the pituitary gland with resultant diuretic effect, holding to the view that this secretion does not exercise the constricting action on the renal vessels that would be inferred from the rise of blood pressure. It will be noted that the latter view is in keeping with the observations of Schafer and his co-workers.

In a review of the literature, one cannot do more than cite some of the evidence which has been brought clearly to light in the etiologic

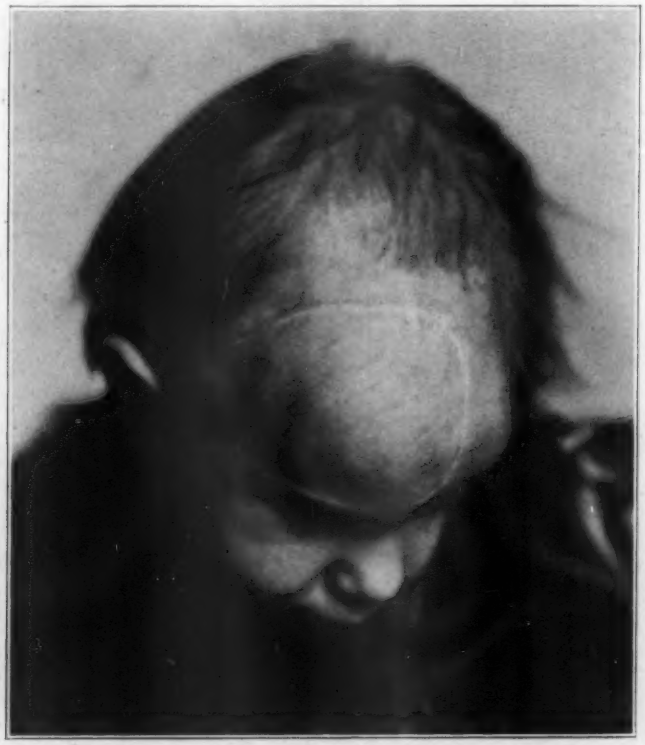

Fig. 5.—Appearance of healed scar.

relationship between the hypophysis and a certain proportion of (some maintain all) causes of diabetes insipidus. It may be said, however, that the brilliant work of Cushing and his associates, together with many observations on the subject from the point of view of the endocrinologist, has served to focus both experimental and clinical attention in this direction. The disturbance of function of the hypophysis is generally considered as being hyposecretion; there are, however,

dissenting opinions. Meyenberg [14] expressed the view, based on his clinical and experimental observations, that the endocrine disturbance is one of hyposecretion and not one of hypersecretion. Simmonds,[15] studying secondary growths of the pituitary body in connection with diabetes insipidus, concluded that this affection, if of pituitary origin, is not due to hyperfunction but to an absence of function of this organ. In one case, a boy, aged 9 years, who had not developed well since his

Fig. 6.—Appearance of child after operation in relation of growth to other children.

fifth year, there was intense polydipsia, polyuria and extreme emaciation. Necropsy revealed a hemorrhagic tumor the size of a walnut on the floor of the third ventricle, projecting toward the sella turcica.

14. Meyenberg: Diabetes Insipidus, Beitr. z. Path. Anat. u. z. allg. Pathol. **61**:550, 1916.

15. Simmonds, M.: Ueber sekundare Geschwülste des Hirnanhangs und ihre Beziehungen zum Diabetes Insipidus, Munchen. med. Wchnschr., 1914.

The pituitary body was macroscopically and microscopically normal. The posterior lobe and the stalk were invaded by sarcomatous tissue of the same kind as that of the tumor of the third ventricle. Moffett [16] noted in some clinical and experimental observations in cases of diabetes insipidus that the disease is distinctly one of hyposecretion, and is relieved temporarily by the administration of 0.5 c.c. of pituitary

Fig. 7.—Appearance of child when the paper was written.

substance, injected subcutaneously from two to three times a day. This led him to believe that disease of the pituitary body or pressure on the floor of the third ventricle is the cause of the entire condition. From certain clinical observations, coupled with assembled experimental

16. Moffett, R. D.: Diabetes Insipidus in Children, M. J. & Rec. **92**:12 (Sept.) 1917.

data, Cushing [17] suggested that not only are the emotional polyurias in all probability the expression of a neurogenic discharge of hypophyseal secretion, but the clinical polyurias are in many instances merely symptomatic expressions of an internal secretory disturbance, brought about by injury or disease involving the hypophyseal region.

OPERATION AND COURSE

The presence of polydipsia and polyuria in this case suggested the diagnosis of diabetes insipidus, but as these are only symptoms of some underlying disease my attention was directed to the pituitary gland. Congenital tumors of the brain involving some portion of the pituitary gland have been generally recognized as one of the causes of diabetes insipidus. In this case, the roentgen-ray picture revealed very definite calcified deposits of a congenital cyst, which was demonstrated by two roentgen-ray examinations, one in New York and one in Boston. Believing that I was dealing with a congenital cyst which was pressing on the pituitary body, but which would be unverified without operation I referred the case to Dr. Harvey Cushing of Boston, for further examination and surgical intervention. He confirmed my findings, and on November 17 Dr. Cushing operated, using a general anesthetic, with a right transfrontal incision for pituitary exposure.

For brevity, I shall give you a short abstract of Dr. Cushing's operation. The bone flaps were reflected without difficulty. The dura was elevated from the orbital plate and the usual incision was made through the dural attachment to the sphenoidal ridge; finally, a good view of the chiasm with the bulging cyst wall in which yellowish flecks were incorporated was obtained. A nick was made in the cyst, and about 25 cc. of orange colored fluid containing cholesterin crystals was withdrawn. The cyst completely collapsed. With pituitary rongeurs, Cushing was able to brush it away from the chiasm, hoping to withdraw the upper portion of it without damaging the chiasm. A second large piece of the cyst wall was then withdrawn from the base, exposing the flattened hypophysis. The entire cyst wall was removed and came away in its entirety. At the conclusion of the operation, Dr. Cushing made the following note: "This mite of a child, aged 3½ years, has diabetes insipidus and primary optic atrophy, probably a bitemporal hemianopsia, and pituitary infantilism. The roentgenogram has revealed calcareous deposits in a suprasellar pharyngeal pouch cyst. The photographs will show that the child was extremely small and frail, and I had many doubts as to whether it was a suitable case for operation on physical grounds alone, and equal doubts as to whether I should be able to withdraw the cyst, for we are often baffled in this procedure. The cyst fortunately was sufficiently tough, so that it could be withdrawn from between the anterior legs of the chiasm after its evacuation."

The child withstood the operation remarkably well. Following the operation, she refused water almost entirely for one to two days. In the first twenty-four hours after operation, her fluid intake was only 200 c.c., whereas before operation it was from 800 to 1,600 c.c. The output, except for 100 c.c. at one urination, was lost through incontinence. The surgical recovery was rapid and free from any unusual symptom, and the child returned from Boston to New York, December 24. Since her return I have stimulated her appetite and instituted appropriate tonic treatment, in conjunction with alpine sunlight exposures and extract of the pituitary gland (anterior lobe) to promote her general body growth and

17. Cushing, H. W.: (1) The Pituitary Body and Its Disorders, Philadelphia, J. B. Lippincott Company, 1912; (2) Concerning Diabetes Insipidus and the Polyurias of Hypophyseal Origin, Bull. Mass. Med. Soc., Medical Communications, **24**:25, Pt. 1, 1913; Boston M. & S. J. **24**, 1913; The Pituitary Gland as Now Known, Lancet **2**:899 (Oct. 31) 1925.

development further. Her appetite is somewhat improved, although still much below normal. Her weight before going to Boston was 19 pounds, 8 ounces, and it is now 27 pounds. Her height was 34½ inches and has not changed. The polydipsia and polyuria have entirely disappeared. Her skin is still somewhat dry and her hair has a dead appearance. Her disposition is much improved. She is more interested in her surroundings and is slowly learning to speak English. Her eyes were re-examined by Dr. Ernest Krug and he reported the following: "There is virtual blindness in the left eye, with an almost complete optic atrophy. There is some light perception and the pupils react to light. The left disk is quite white; the vessels are of normal caliber; however, there is primary atrophy. The right eye nerve head looks very good; there is a slight pallor on the temporal side. The vessels are normal and her vision in this eye is 20/30 in a good field."

SUMMARY

This child presented polydipsia and polyuria, with a definite roentgenogram revealing a craniopharyngeal pouch cyst. The symptoms of diabetes insipidus have not returned since the operation. Her recovery seems assured, except for optic atrophy in the left eye and a general disability, which I hope time and intelligent care will repair.

70 East Seventy-seventh Street.

AURICULAR FLUTTER WITH CONGENITAL HEART DISEASE *

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With the rapidly increasing use of the electrocardiograph in clinical medicine, the recognition of auricular flutter is no longer a rarity. During the last few years, numerous articles have appeared in the literature dealing with the clinical features of this abnormal cardiac mechanism. In virtually all of the recorded cases the patients were adults, although Lewis [1] reported a case of flutter in a child (age not mentioned), and Koplik [2] reported the condition in a boy, aged 10 years. Blacher [3] noted the possibility of the existence of transient auricular flutter while examining a child, aged 8 years, who had diphtheria.

We observed a child with congenital heart disease from the age of 2½ to 5 years, who had auricular flutter a month preceding death. The association of these two conditions is extremely rare, and it is unusually interesting in this particular case because of the correlation with the subsequent anatomic findings.

REPORT OF CASE

History.—A girl, aged 2½ years, was first brought to the Mayo Clinic June 20, 1923, because of swelling and tenseness of the abdomen. The child was a full-term baby weighing 10 pounds. The delivery was instrumental after a twenty-four hour labor. No cyanosis, convulsions or coma was noted after the delivery. The child was breast-fed for the first eleven months and appeared well except that she was a "mouth breather." Following an attack of acute tonsillitis a year before examination, swelling around the eyes, and slight swelling of the feet and ankles was noted. She was said to have had cystitis. Six months before examination she was quite seriously ill with bronchopneumonia, the illness lasting about three or four weeks. After this she was listless, did not play as formerly and continued to have a troublesome, unproductive cough. Occasionally there was cyanosis of the face and lips. She gradually became shorter of breath, her abdomen became enlarged and her legs were swollen; these symptoms were at their maximal severity at the time of her admission to the clinic.

Examination.—The child appeared critically ill, dyspneic and markedly cyanosed; the face particularly exhibited the characteristic cardiopathic facies. The

* Received for publication, March 8, 1926.

* From the Section on Pediatrics and the Section on Cardiology, Mayo Clinic.

1. Lewis, Thomas: Lectures on the Heart, New York, Paul B. Hoeber, 1915, p. 116; The Mechanism and Graphic Registration of the Heart Beat, New York, Paul B. Hoeber, 1921, pp. 261-270; Observations Upon Flutter and Fibrillations. Part I. The Regularity of Clinical Auricular Flutter, Heart **7**:127-131, 1920.

2. Koplik, H.: Paroxysmal Tachycardia in Children, Am. J. M. Sc. **154**: 834-851, 1917.

3. Blacher, W.: Die Beteiligung des Nervensystems an den Störungen der Herzschlagfolge bei Diphtherie, Jahrb. f. Kinderh. **101**:13-80, 1923.

heart was enormously enlarged, the left border extending to the median axillary line, and visible and palpable impulses were noted chiefly over the right precordial area. There was no arrhythmia but the rate was rapid (140 each minute). A loud, blowing, prolonged murmur was audible over the whole precordium, maximal to the left of the upper third of the sternum, and seeming to extend into the diastolic phase. Bronchovesicular breathing was audible over both sides of the chest and numerous moist râles were noted. The liver was markedly enlarged, extending well below the level of the umbilicus. The spleen likewise was palpable below the left costal border. There was a moderate degree of ascites and of dependent edema.

Laboratory Findings.—Fifty cubic centimeters of urine was collected during a twelve-hour period, the specific gravity was 1.019; there was a moderate amount of albumin and an occasional leukocyte and erythrocyte in the sediment. Subsequent urinalyses were similar. The hemoglobin was 68 per cent (Dare), the erythrocytes numbered 3,840,000, and the leukocytes 11,800. The differential study

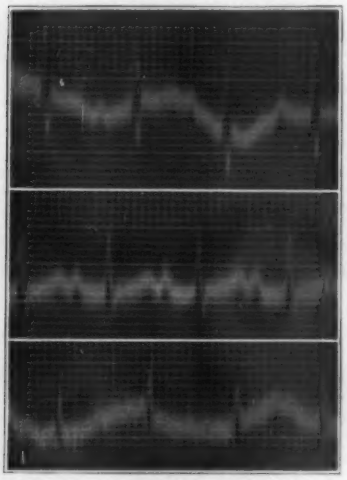

Figure 1

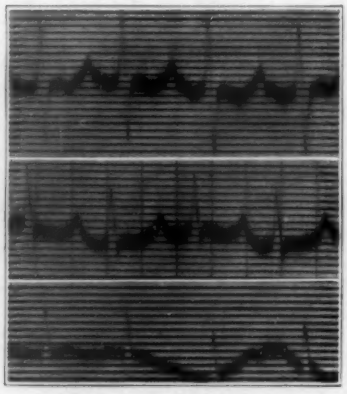

Figure 2

Fig. 1.—June 26, 1923, sinus arrhythmia, right ventricular preponderance.
Fig. 2.—June 2, 1924, sinus tachycardia, right ventricular preponderance.

showed 33 per cent lymphocytes, 3 per cent large mononuclear cells, 2.5 per cent transitionals, 60 per cent neutrophylic polymorphonuclear cells, 0.5 per cent eosinophils and 1 per cent basophils. A slight degree of anisocytosis, poikilocytosis and polychromatophilia was noted. Examination of the ocular fundi revealed only engorgement of the veins. Roentgenographic studies of the chest verified the enormous cardiac enlargement. The electrocardiogram showed marked sinus arrhythmia and preponderance of the right ventricle.

A diagnosis of congenital heart disease was made.

During the nine days the child was under observation in the hospital she improved moderately, and was referred to her home physician. Rest and the intermittent administration of digitalis were recommended.

The child was seen two months later, and was definitely improved. The cardiac findings were essentially the same as on the previous visit except that the loud murmur was no longer audible. A continuation of the cardiac regimen was recommended, and the child was taken home. She was again examined in December, when no particular change in the condition was evident. The liver

and spleen were still palpable but distinctly smaller than on the previous visits. The anasarca was greatly diminished.

In March, 1924, the child was ill with bronchitis, and a temporary upset again occurred. She was brought to the clinic on June 2. The cardiac findings were unchanged; otherwise, improvement was distinctly noticeable. The systolic blood pressure, taken without special precautions, was 96, the diastolic 62, and the pulse rate 120. Electrocardiograms revealed a rate of 129, sinus tachycardia and preponderance of the right ventricle.

Sept. 28, 1925, the child was brought to the clinic seriously ill. The edema and ascites had reappeared during the previous two months, dyspnea and cyanosis were marked and cough was very distressing. The heart was enormously enlarged, the rate rapid (122 each minute), the tones were distinct and lacked definition; the murmur which was audible on the child's first examination was not present. She had intermittent fever, as high as 102.6 F. The lungs were markedly congested, the abdomen was tense with ascites, and dependent edema was marked. Repeated urinalyses revealed slight traces of albumin and occasionally a few hyaline casts. The other laboratory data, except the electrocardiograms, showed nothing significant. The electrocardiogram taken September 30 revealed the presence of auricular flutter, the ventricular rate being 105 and the auricular rate 330, with varying degrees of 2:1 to 4:1 block. There was also evidence of right ventricular preponderance.

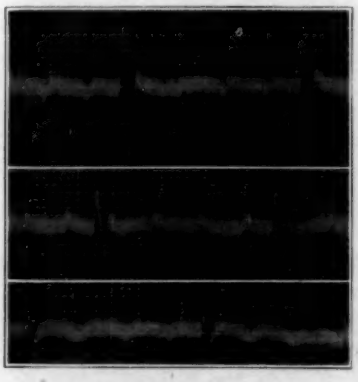

Figure 3

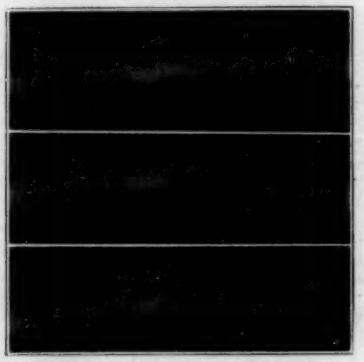

Figure 4

Fig. 3.—Sept. 30, 1925, auricular flutter, varying degree of block. Ventricular rate 105, auricular rate 330, right ventricular preponderance.

Fig. 4.—Oct. 7, 1925. Auricular flutter, varying degree of block, ventricular rate 71, auricular rate 315, right ventricular preponderance.

Digitalis, novasurol and ammonium chloride were given, but it was necessary to resort to abdominal paracentesis. After the withdrawal of 2,000 cc. of clear amber fluid, a very large liver could be palpated. Digitalis was administered to the point of producing complete auriculoventricular dissociation, the ventricular rate dropping to 53 and the auricular rate to 107, but it was impossible to alter the abnormal mechanism. The child grew worse progressively, and died on the thirtieth day after her last admission to the hospital.

ELECTROCARDIOGRAMS

The first electrocardiogram was taken at the time of the child's first admission, and showed only a sinus arrhythmia with preponderance of the right ventricle (fig. 1). The second record was obtained a year later,

and showed a heart rate of 129, normal rhythm, and preponderance of the right ventricle (fig. 2). No further records were obtained until the patient's last admission, when auricular flutter was discovered. The rate of the ventricles was 105 and that of the auricles 330, with degrees of block varying from 2:1 to 4:1 (fig. 3).

Figures 4, 5, and 6 definitely demonstrate the effect of digitalis. Oct. 7, 1925, marked slowing in ventricular rate had occurred. The ventricles were beating at the rate of 71 each minute. The auricles were still rapid, 315 each minute (fig. 4). October 14, the ventricular rate was 72 and the auricular rate 287 (fig. 5). The last tracing obtained was October 21, and showed complete auriculoventricular dissociation with ventricular premature contractions. The auricular rate was 115 each minute (fig. 6).

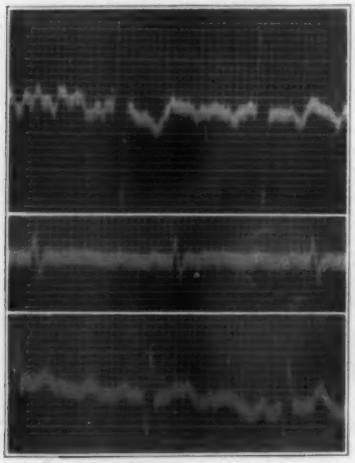

Figure 5

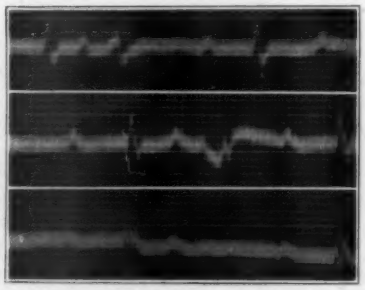

Figure 6

Fig. 5.—Oct. 14, 1925, auricular flutter, varying degree of block, ventricular rate 72, auricular rate 287, right ventricular preponderance.

Fig. 6.—Oct. 21, 1925, auricular flutter with complete A-V dissociation, coupled ventricular premature contractions.

NECROPSY

The heart was markedly enlarged, weighing 137 Gm. (fig. 7). According to Scammon, the absolute weight of the heart of the full-term new-born child is from 20 to 25 Gm., and that this weight is trebled in four years. The foramen ovale was patent, the diameter being about 2.5 cm., and there was marked dilatation of the right auricle with a very unusual degree of hypertrophy. The tricuspid ring was widely dilated and the musculature of the right ventricle was greatly hypertrophied. There was marked dilatation of the pulmonary artery. Histologic study

showed nothing of note other than the hypertrophy of the muscle fibers of the heart. There were no valvular lesions nor was the pericardium diseased. An abscess, probably embolic in origin, was found in the upper lobe of the right lung with areas of bronchopneumonia and collapse of the lung. A marked degree of hepatic cirrhosis was present, the liver weighed 766 Gm. (according to Scammon [4] the average weight of the normal liver of a child, aged 3 years, is about 400 Gm.). No other significant lesions were found.

Fig. 7.—The heart with the right auricle opened, showing the marked muscular hypertrophy and dilatation. The patent foramen ovale is plainly visible.

COMMENT

Many attempts have been made to correlate auricular flutter with histopathologic findings in the auricles, but as yet no uniform or convincing association has been demonstrated. Until more adequate proof is available, we must be content to accept the view that flutter occurs as the result of some physiologic disturbance of auricular function. The

4. Scammon, R. E.: Abt's Pediatrics, Philadelphia, W. B. Saunders Company, **1**:329, 393, 1923.

results of the investigations of Lewis and his co-workers [5] formulating the theory of "circus movement" has supplied a very tenable conception of this disorder.

One of the striking features of the case reported here is the association of flutter with congenital heart disease, in which marked cardiac insufficiency had existed for a relatively long period. In spite of two rather severe infections, no evidence of preexisting or recent inflammatory disease of the heart could be found in the sections. We may possibly assume that dilatation and hypertrophy of the right auricle reached such a degree as to interfere with the orderly function of this chamber, which would imply in this case that the development of flutter was dependent on the extreme dilatation and hypertrophy of the right auricle.

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5. Lewis, Thomas; Feil, H. S., and Stroud, W. D.: Part II. The Nature of Auricular Flutter, Heart **7**:191-245, 1920; Part III. Some Effects of Rhythmic Stimulation of the Auricle, Heart **7**:247-291, 1920. Lewis, Thomas: Part IV. Impure Flutter; Theory of Circus Movement, Heart **7**:293-345, 1920. Lewis, Thomas; and Cotton, T. F.: Part V. Certain Effects of Faradic Stimulation of the Auricle, Heart **8**:37-57, 1921. Lewis, Thomas; Drury, A. N., and Bulger, H. A.: Part VI. The Refractory Period and Rate of Propagation in the Auricle; Their Relation to Block in the Auricular Walls and to Flutter, etc., Heart **8**: 83-139, 1921; Part VII. The Effects of Vagal Stimulation, Heart **8**:141-169, 1921.

PROGRESS IN PEDIATRICS

REVIEW OF THE LITERATURE ON SYPHILIS*

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An attempt has been made to include in this review the more important additions to the knowledge of syphilis, particularly hereditary syphilis, since the last comprehensive review of the subject in this journal.[1] Publications dealing with certain phases, such as the technic of the Wassermann reaction, have been purposely omitted. The bibliography of those phases which are discussed is by no means complete, only representative publications having been selected.

INCIDENCE OF SYPHILIS

A definite determination of the incidence of hereditary syphilis is impossible from any data now available. Most of the studies concerning its incidence are open to the criticism of having dealt with selected groups. As have others before them, Belding and Hunter[2] have observed the incidence of syphilis to increase as the social and economic scale is descended. Nearly 14 per cent of adult patients cared for in the hospital free of charge were syphilitic, while among those paying a moderate fee the proportion found to be syphilitic was in the neighborhood of 9 per cent. When the patients were classified by occupation, the highest incidence, 16.3 per cent, was found in the clerical group and the lowest, 7.9 per cent, in the manufacturing group. An incidence of 10.3 per cent was noted among multiparous women, as contrasted with 7.9 per cent among primiparous women. This they interpret to indicate that the longer a woman has been married, the greater are her chances of contracting the infection from her syphilitic husband.

That race also plays an important rôle in the incidence of syphilis is well recognized. Welz and Van Nest,[3] in a study of 768 pregnant negresses of Detroit, found 19.3 per cent of them to be syphilitic. In the same clinic the incidence among 699 pregnant white women was 5.9 per cent. Barenberg and Rosenberg[4] found syphilis to be present

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1. White, Park J.: A Review of the Literature of Syphilis in Infancy and Childhood, Am. J. Dis. Child. **23**:442 (May) 1922; ibid., 535 (June) 1922.

2. Belding, D. L., and Hunter, I. L.: Wassermann Test, VI: The Influence of Race and Nationality, Am. J. Syph. **9**:119 (Jan.) 1925.

3. Welz, W. E., and Van Nest, A. E.: Observations on the Treatment of Syphilis in Pregnancy in the Department of Health in Detroit, Am. J. Obst. **4**: 174 (Aug.) 1922.

4. Barenberg, L. H., and Rosenberg, P.: The Incidence of the Wassermann Reaction in a Large Child Caring Institution, Arch. Pediat. **39**:23 (Jan.) 1922.

in less than 1 per cent of 472 orphans from the poorest Jewish families in New York City.

Smith,[5] in a study of 11,205 orphaned children, found a strongly positive Wassermann reaction in 1.2 per cent, and a weakly positive reaction in an additional 2.3 per cent. The significance of the weakly positive reactions is brought into question by the fact that evidence of syphilis was presented by only thirteen of 175 members of the families of the children manifesting the weak reactions, whereas positive evidence of syphilis was presented by nine of eleven relatives of the children manifesting strong reactions.

Lawrence[6] finds that in New York state, exclusive of New York City, approximately 250 syphilitic children are recognized annually, and that the mortality in this group is high.

Findlay[7] estimates that 1 per cent of the infant population of Glasgow has syphilis. This is in contrast with a former estimate by Findlay and Cruickshank, that 10 per cent of the infant inhabitants were syphilitic. Findlay found that 9 per cent of 1,881 mothers had a positive Wassermann reaction, while the cord blood gave a positive reaction in only 4.2 per cent of the 1,350 infants studied. In forty-four of the infants having positive cord blood Wassermann reactions, the reaction became negative before the child reached the age of 20 months. In only four instances did the Wassermann reaction remain permanently positive. This study, together with a study of his patients seen at the hospital, leads Findlay to conclude that the incidence of syphilis among the children is considerably less than 1 per cent.

Belding,[8] in a study of 5,000 unselected maternity cases, observed a positive Wassermann reaction in 9.2 per cent. In this group clinical manifestations were definite in only 0.54 per cent, and were suggestive in an additional 1.7 per cent.

TRANSMISSION TO THE SECOND GENERATION

That the mother is infected in every instance of transmission to the second generation is generally conceded. No recent study has been noted purporting to show that the infection could be transmitted directly from the father to the offspring. Perhaps the chief basis for assuming the existence of direct paternal transmission is the well recognized fact

5. Smith, F. C.: Syphilis Complement Fixation Reaction in Pregnancy with Special Reference to the Kolmer Reaction, Am. J. Syph. **6**:705 (Oct.) 1922.

6. Lawrence, L. S.: Congenital Syphilis: A Public Health Problem, J. A. M. A. **82**:1252 (April 19) 1924.

7. Findlay, Leonard: Reflections on Congenital Syphilis, Am. J. Dis. Child. **28**:133 (Aug.) 1924.

8. Belding, D. L.: The Wassermann Test: IX. The Detection of Syphilis in Prenatal Clinics, Am. J. Obst. & Gynec. **9**:203 (Feb.) 1925.

that the majority of mothers of syphilitic children present little or nothing in their history, or by examination, which might lead to the diagnosis of syphilis. Browne [9] states that 95 per cent of the mothers of syphilitic infants show no symptoms and give no history of syphilis. In explanation of this fact, evidence has been presented which indicates that pregnancy alters markedly the usual course and behavior of syphilis. From his experiences, Williams [10] concludes that: "there must be something about the pregnant condition which mitigates the virulence of the disease and predisposes to spontaneous cure." He found pregnant syphilitic women "unusually amenable to antisyphilitic treatment."

Moore [11] also has called attention to the effect of pregnancy on the course of syphilis. He finds that when impregnation and syphilitic infection occur simultaneously, a complete suppression of all early symptoms of syphilis may result. If early symptoms appear, they are likely to be milder than in those in whom pregnancy has not been a complication. He notes also that pregnancy alters the time relationships between the stages of syphilis, and that it often affects the Wassermann reaction in an unusual manner. It is also noted that the evidence of neurosyphilis among child-bearing women is much less than among barren women or among men. This difference is attributed to the effect of pregnancy.

As a means of maternal infection, the idea that spirochetes are present in the semen of syphilitic men is gaining ground. Lakaye [12] was able to demonstrate spirochetes microscopically in the semen of five of twenty-two patients examined. In two instances the spirochete was attached to a spermatozoon. Spirochetes were demonstrated also by animal inoculation. This, with similar observations made previously by other writers, makes it increasingly unnecessary to assume a hypothetic spore or resting stage of the spirochete, in order to account for transmission by a syphilitic man in whom the disease is latent.

That the adult male member of the family is the usual means by which syphilitic infection gains entrance to the family is a reasonable presumption. Cooke and Jeans [13] state that 40 per cent of the fathers

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9. Browne, Francis J.: On the Influence of Pregnacy on the Wassermann Reaction and on the Clinical Manifestations of Syphilis, J. Obst. & Gynec. Brit. Emp. **30**:519, 1923.

10. Williams, J. Whitridge: The Influence of Treatment of Syphilitic Pregnant Women Upon the Incidence of Congenital Syphilis, Bull. Johns Hopkins Hosp. **33**:383 (Nov.) 1922.

11. Moore, J. E.: Studies on the Influence of Pregnancy in Syphilis. 1. The Course of Syphilitic Infection in Pregnant Women, Bull. Johns Hopkins Hosp. **34**: 89 (March) 1923.

12. Lakaye, R.:· Le treponeme dans le sperme, Arch. méd. belges **75**:385 (May) 1922; abstr. J. A. M. A. **79**:686 (Aug. 19) 1922.

13. Cooke, J. V., and Jeans, P. C.: The Transmission of Syphilis to the Second Generation, Am. J. Syph. **6**:569 (Oct.) 1922.

of syphilitic children examined gave a negative Wassermann reaction. They assume that these fathers were able to transmit the infection even though the infection was latent.

Rietschel [14] has proposed an interesting and plausible hypothesis to explain certain phases of transmission of syphilis to the second generation. In experimental work with animals, the behavior of syphilitic infection depends on the site of inoculation. In apes, general disease follows inoculation on the skin and intravenously. General disease seldom follows inoculation subcutaneously, and never follows intraperitoneal inoculation. The testis proves a good growing place. In rabbits, general disease follows testicular and intravenous inoculation, while inoculation into the eye merely causes a localized disease. In latent syphilis of the human male, the sperm must carry the spirochetes in cases of transmission. When infection takes place in the female in a visible area, both primary and secondary manifestations are to be observed. When the primary infection site is the vagina or cervix, secondary manifestations appear, though the primary lesion may be overlooked. In either case the disease becomes general, and the subject is aware of it. Rietschel [14] assumes that the intra-uterine changes during menstruation, or those accompanying the ripening of the ovum, render the endometrium vulnerable to infection with the spirochete. He assumes that implantation at this site leads to localized rather than to generalized disease, thus accounting for the fact that such a large proportion of mothers of syphilitic children are quite unaware of their infection. This also explains the occurrence of abortions and early miscarriages, with absence of syphilitic changes in the fetus. Evidence of syphilis in the fetus is found only rarely before the seventh month and never before the fifth month, yet, on a statistical basis, the abortions are presumably due to syphilis. As the local uterine disease becomes older and increasingly latent, pregnancies are permitted to continue nearer to term with the birth of syphilitic children finally. The infection of the fetus may take place in either of two ways, namely, in a smaller proportion it occurs by way of the placenta before birth, merely by extension of the uterine disease to the placenta. In a larger proportion, the infection takes place at the time of birth through the intermingling of maternal and fetal blood in the pools of blood which form when hard pains partially separate the placenta from the uterine wall. The mixture of blood at this time also accounts for the transfer of Wassermann bodies from the mother to the fetus, an event which is by no means rare. Infection at this late period of fetal life accounts for the latent period of syphilis shown by such a high proportion of

14. Rietschel, Hans: Das Problem der Übertragung der Angeborenen Syphilis, Dermat. Wchnschr. **80**:91 (Jan. 17) 1925; ibid. **80**:123 (Jan. 24) 1925.

syphilitic infants. The latent period is variable, and may be as long as twelve weeks. This variation, though it may have several causes, is to be explained most readily by the variation in the number of spirochetes transferred.

Cooke and Jeans [13] have noted a number of apparent vagaries in the transmission of syphilis to the second generation. Maternal syphilis, latent to such an extent that the Wassermann reaction is negative, usually does not cause infection of the offspring. Several instances are cited of the prenatal transmission of syphilis from mothers with a negative Wassermann reaction to their infants. When the mother's Wassermann reaction is strongly positive, the infants were syphilitic in about 70 per cent of the cases. Such mothers may give birth to nonsyphilitic children. When the mother's Wassermann reaction was weakly positive, the number of nonsyphilitic children was from six to eight times the number of syphilitic children born. Cooke and Jeans [13] also note that identical twins share the same fate as regards infection—both are infected or both escape. In the case of double ovum twins, conditions are comparable to two successive pregnancies—either, neither or both may be infected. These authors also call attention to the well known fact that the more recent the maternal infection, the greater is the incidence of fetal infection, and the more pronounced are the infantile manifestations.

Directly related to transmission to the second generation is the behavior and reliability of the Wassermann reaction in the pregnant woman, concerning which a difference of opinion exists. Belding and Adams,[15] in a study of over 5,000 subjects, state that the Wassermann reaction is not a reliable means of diagnosing syphilis in pregnant women. Using a 0.4 per cent cholesterolized beef heart antigen, with water bath fixation, ten times as many falsely positive reactions were noted in the pregnant as in the nonpregnant women, while the number of falsely negative tests was the same in the two groups. Moore [11] also questions the reliability of the Wassermann reaction in pregnancy. In thirty-three of 200 cases studied, the reaction was anomalous. In seven primiparas, and in eighteen multiparas, the Wassermann reaction vacillated from day to day, indicating that the test on any single occasion, or even on several occasions, may be unreliable. Hinton,[16] in reviewing a series of 10,427 Wassermann reactions, finds no cause to question this reaction in pregnancy, in which condition the reaction is stated to be fully as specific as in control cases. Smith,[5] using the usual technic with three antigens and Kolmer's technic in a study of

15. Belding, D. L., and Adams, C. B.: The Wassermann Test in a Boston Maternity Hospital, Boston M. & S. J. **187**:815 (Dec. 7) 1922.

16. Hinton, W. A.: The Wassermann Reaction in Pregnancy, Am. J. Syph. **7**:155 (Jan.) 1923.

ninety-four pregnant women, found no anomalous reactions. He concludes that if pregnancy is capable of producing unreliable reactions, evidence of unreliability would be found more frequently. Browne [9] finds the Wassermann reaction but little modified by pregnancy. Those mothers who give a positive reaction during pregnancy give an equally positive test after delivery.

TRANSMISSION TO THE THIRD GENERATION

From time to time, reports of transmission to the third generation appear. Higoumenakis [17] collected several such reports from the literature and added thirteen cases of his own, in which he believed the infection to have been transmitted to the third generation. Cooke and Jeans [13] believe such transmission entirely possible, but that the event is impossible to prove since superimposed acquired infection cannot be ruled out.

THE PROPHYLAXIS OF HEREDITARY SYPHILIS

Williams [10] found that 48.5 per cent of the children born to untreated syphilitic mothers were syphilitic, while with treatment of the mother the proportion of infected children became 6.7 per cent. Of the 113 treated mothers in the group studied, only fifteen were delivered before term, a proportion no greater than is found in a nonsyphilitic group.

Bartholomew [18] reports that 34 per cent of the children born to 300 untreated syphilitic negresses were born syphilitic. The institution of prophylactic treatment produced very striking results. Prematurity was reduced to one-half, stillbirths were reduced to one-third, abortions to one-seventh and infant mortality to one-ninth of that found previously in an untreated group. The period of treatment averaged from 7.4 months of pregnancy to term.

Cooke and Jeans [13] found that prophylactic treatment during pregnancy would, as a rule, protect the infant against infection. In the average case, surprisingly little treatment is sufficient; however, they cite one case in which a fairly large amount of mercury failed to protect the fetus.

FAMILIAL NEUROSYPHILIS

Moore and Keidel [19] concluded that certain families possessed a very marked tendency to develop neurosyphilis, and that in a family

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17. Higoumenakis, G.: La syphilis hereditaire de seconde generation et son traitement, Ann. de mal vén **9**:401 (June) 1924.

18. Bartholomew, R. A.: Syphilis as a Complication of Pregnancy in the Negro, J. A. M. A. **83**:172 (July 19) 1924.

19. Moore, J. E., and Keidel, A.: Studies in Familial Neurosyphilis; Familial Neurosyphilis from Various Extra Familial Sources: A Clinical Contribution to Question of Neurotropism, J. A. M. A. **80**:818 (March 24) 1923.

group the same type of neurosyphilis is likely to be found. Kemp and Poole [20] studied twenty families in which congenital neurosyphilis occurred, and twenty syphilitic families in which there was no hereditary neurosyphilis. In the neurosyphilitic group, ninety pregnancies resulted in forty-four living children, of whom thirty-two were syphilitic. Of the syphilitic children twenty-two had neurosyphilis, half of these developing paresis. In the control group, with no neurosyphilis among the children, 102 pregnancies resulted in sixty-two living children of whom twenty-eight had syphilis. In the control group, 5 per cent of the mothers presented evidence of neurosyphilis, while in the other group 40 per cent of the mothers presented such evidence. This difference is sufficiently striking to suggest a neurotropic strain of *Spirocheta pallida* responsible for the production of neurosyphilis. Familial predisposition to neurosyphilis may, however, be a factor of equal importance in determining this type of disease.

FETAL MORTALITY

Couvelaire [21] found that when the mother contracted syphilis during gestation, the fetal mortality was 70 per cent. If the maternal syphilis was recent, but contracted before gestation, the fetal mortality was 65 per cent. When syphilis in the mother was an old infection, the fetal mortality was only 20 per cent. This last is only little more than what is considered a "normal mortality."

MANIFESTATIONS OF HEREDITARY SYPHILIS

Although syphilis is protean in its symptomatology, comparatively few of its manifestations are now known which were not recognized and described by the early writers. Findlay [22] recently stated that: "I think it can truly be said that the Wassermann reaction has revealed to us no single evidence of congenital syphilis, with the possible exception of eczema ores syphiliticum which was unknown to our predecessors." Some recent observations, however, if not entirely new, are of interest.

Klauder and Solomon,[23] in a study of twenty-three cases of juvenile paresis, note that the early diagnosis often is difficult. Usually, the examination of the cerebrospinal fluid offers the only means of making a differential diagnosis. Quite commonly the syphilis has been over-

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20. Kemp, J. E., and Poole, A. K.: Familial Neurosyphilis, J. A. M. A. **84:** 1395 (May 9) 1925.

21. Convelaire, A.: Du rôle des consultations prénatales dans da lutte contre la mortalité infantile, Presse méd. **32:**2159 (Dec. 24) 1924.

22. Findlay, Leonard: Footnote 7.

23. Klauder, J. V., and Solomon, H. C.: Juvenile Paresis: With a Presentation of Twenty-Three Cases, Am. J. M. Sc. **166:**545 (Oct.) 1923.

looked, and a diagnosis of epilepsy or idiocy has been made. These investigators find in juvenile paresis that the motor symptoms come on at an earlier stage than in the adult. The parents of four of their patients were cerebral syphilitic subjects, and two of the patients were sisters. The authors note that the prognosis in juvenile paresis is entirely bad, remissions are practically unheard of and treatment has only little effect.

Keidel and Kemp [24] call attention to the overlooked frequency with which the auditory apparatus is involved. They find such involvement in 10 per cent of all hereditary syphilitic patients, and in frequent association with parenchymatous keratitis. The Wassermann reaction is positive in 90 per cent of the cases. The symptoms may develop slowly or the process may be completed in a week. No return of function has been observed. Although the symptoms may develop at any time between 7 and 27 years, the usual age is in the neighborhood of 14 years.

Luhr [25] reports the simultaneous development of oculomotor palsy and parenchymatous keratitis. He collected six similar cases from the literature, and states that the condition is rare. It occurs between 1 and 6 years of age, and the prognosis is good with treatment.

Weiss and Izgur [26] made a serologic survey among 1,633 inmates of institutions for the care of feebleminded children. They found 2.5 per cent of these children to be definitely syphilitic, and an additional 2.7 per cent were considered as doubtfully so. Since the incidence of syphilis in this group was no greater than is found in the general population, the authors believe that syphilis is not a frequent cause of amentia.

Gill [27] reports the finding of laryngeal syphilis in a boy, aged 12 years, whose mother had died of syphilis of the larynx. The process was painless and had produced a speech defect and difficulty in breathing, especially at night, for a period of eight or nine months, but it responded promptly to treatment.

Elmer [28] reports the case of a girl, aged 14 years, who developed a typical Charcot joint at the hip. In spite of vigorous antisyphilitic treatment, a similar condition developed at the opposite hip.

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24. Keidel, A., and Kemp, J. E.: Deafness in Late Congenital Syphilis, South. M. J. **16**:647 (Sept.) 1923.

25. Luhr, A. F.: Oculomotor Palsy with Parenchymatous Keratitis in Congenital Syphilis, Am. J. Ophth. **7**:293 (April) 1924.

26. Weiss, Max, and Izgur, Leon: Syphilis as a Factor in the Etiology of Mental Deficiency, J. A. M. A. **82**:12 (Jan. 5) 1924.

27. Gill, E. G.: Syphilis of the Larynx in Children: With Report of a Case, Virginia M. Month. **52**:255 (July) 1925.

28. Elmer, W. G.: Juvenile Tabes Dorsalis with Destruction of Hips from Charcot's Disease, M. J. & Rec. (Supp.) **119**:70 (April 2) 1924.

Campas [29] studied the histopathology of the kidney in a group of syphilitic infants and fetuses. He found the lesions of the kidney to be more uniform and characteristic than those of any other part of the body; also that spirochetes are more readily demonstrable in the kidney than in any other tissue in the case of macerated fetuses. He found spirochetes in the kidneys in fifty-two of fifty-seven syphilitic patients studied. He states that the tubules normally are entirely formed at birth, but in hereditary syphilis there is a retardation in this respect. The parenchyma is always normal in the case of the stillborn infant, but in those infants on whose kidneys the strain of extra-uterine life has been placed, parenchymatous nephritis develops. Sufficient myeloid tissue exists in the kidney to cause considerable resistance to autolysis. Thus, kidney study in macerated fetuses is facilitated.

THE DIAGNOSIS OF SYPHILIS

The death of August Von Wassermann, March 16, 1925, marked the close of an important epoch in the diagnosis of syphilis. Although the reaction which bears his name has never been fully explained, it is the universal standard by which all other tests for the diagnosis are evaluated.

Relatively little has been added recently to our interpretation of the Wassermann reaction in regard to the diagnosis of syphilis. Cooke and Jeans [18] have expressed the opinion, based on their own observations, that a syphilitic infant will manifest a positive reaction by 2 months of age. If the reaction is negative at 2 months of age, or later, it remains negative and syphilis may be excluded. These authors also call attention to occasional overlapping of the complement fixation test for syphilis and that for tuberculosis. A child manifesting a strongly positive reaction for tuberculosis often manifests a weakly positive reaction for syphilis. This should not lead to an incorrect diagnosis in the child, though it does not infrequently in the adult.

THE KAHN TEST

Flocculation tests are receiving increasing attention. In many places some form of this test is carried out in conjunction with the Wassermann reaction, and in a few places this test has supplanted the Wassermann test. The test described by Kahn [30] has attained considerable popularity. This is a modification of flocculation tests of Sachs-Georgi,

29. Campas, Ernesto de Souza: Pathological Changes in the Kidney in Congenital Syphilis, Bull. Johns Hopkins Hosp. **34**:253 (Aug.) 1923.

30. Kahn, R. L.: A Simple Quantitative Precipitation Reaction for Syphilis. Preliminary Communication, Arch. Dermat. & Syph. **5**:570 (May) 1922.

Meinecke, and others. Kahn's method of performing the test obviates some of the technical difficulties of other flocculation tests.

Anderson and Fischer,[31] testing both blood and cerebrospinal fluid, found the Kahn test gave results in agreement with those of the Wassermann test in 68.3 per cent. In cases of disagreement the Kahn test gave the weaker reaction. These investigators believe the test to have great possibilities when more thoroughly studied.

Detweiler [32] has performed 1,540 parallel Wassermann and Kahn tests. He found agreement in 94.2 per cent of the cases. In fifty-one instances of positive Wassermann reactions and negative Kahn reactions, eleven of the patients were syphilitic. In thirty-nine instances of positive Kahn and negative Wassermann reactions, twenty of the patients were proved to have syphilis. The conclusion is reached that the Kahn test, while not yet the equal of the Wassermann test, is of value because of the ease with which it is carried out.

Keim and Kahn,[33] examining 1,000 cerebrospinal fluids, found close agreement between the Wassermann and the Kahn tests. In eighteen instances in which the fluid was anticomplementary, as shown by the Wassermann test, the Kahn test gave definitely positive or negative reactions.

Holmes,[34] in the study of 1,000 serums by parallel Wassermann and Kahn tests, found a close correlation between the tests, with the balance in favor of the Kahn test. The Kahn test was found of especial value in instances in which the serum was anticomplementary. It is believed that with more study and a better standardization of the antigens, the Kahn test may relieve the laboratory of the intricacies of the Wassermann test.

Kendrick and Lowe [35] have performed parallel Kahn tests on hemolyzed and nonhemolyzed serums. They found that reliable results may be obtained with moderately and markedly hemolyzed serums, and believe that this fact is of considerable importance in districts in which the laboratory is not readily available.

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31. Anderson, F. J., and Fischer, E. F.: Comparison of Wassermann and Kahn Tests in Three Hundred and Twenty-Nine Cases, New York M. J. & Rec. **118**:490 (Oct. 17) 1923.

32. Detweiler, H. K.: The Value of the Kahn Precipitation Test for Syphilis, J. A. M. A. **81**:815 (Sept. 8) 1923.

33. Keim, H. L., and Kahn, R. L.: Clinical Studies on the Kahn Reaction for Syphilis. III. The Test with Spinal Fluid, J. A. M. A. **84**:881 (March 21) 1925.

34. Holmes, Janet A.: The Kahn Precipitation Test for Syphilis, J. A. M. A. **81**:294 (July 28) 1923.

35. Kendrick, P. L., and Lowe, M. K.: Use of Hemolyzed Specimens in Kahn Test, Am. J. Pub. Health **15**:772 (Sept. 15) 1925.

EXAMINATION FOR SPIROCHETES

Gilbert and Bartels [36] have reviewed the methods of staining dried preparations for the purpose of examining for spirochetes. Using the method devised by Fontana, spirochetes were found in 80 per cent of the preparations from material known to contain spirochetes. Eleven other methods were studied, with positive results ranging from 60 per cent to zero.

A method of examining the cerebrospinal fluid for the presence of spirochetes has been devised by Wile and Kirchner [37] by the combination of two older procedures. The organic material of the fluid is precipitated by Alzheimer's method. This material is then stained by the Warthin-Starry method. In 115 fluids studied by this and by closely related methods, the results were positive in nine instances and suggestive in three.

Slodin and Lesser [38] have found that the serum from the cantharides collodion blister contains an abundance of spirochetes in cases of acquired syphilis in the primary and secondary stages, and in cases of infantile hereditary syphilis. This procedure is not of value in late syphilis in the absence of skin lesions.

Vulovic,[39] as a means of early diagnosis, examined for spirochetes scrapings from the umbilical cord at a point near the infant. Positive results were obtained in seven of 1,017 cases. He concluded that this procedure is adequate for diagnosis, though insufficient evidence is presented to show that those in whom the spirochetes were not found were not syphilitic.

HUTCHINSON TEETH

Mebane [40] reports a case in which the patient was a mongolian idiot with typical Hutchinson teeth, and in whom no evidence of syphilis was found. Wassermann tests with serum from the patient and from the remainder of the family gave negative results. The family history was negative in regard to syphilis.

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36. Gilbert, Ruth; and Bartels, H. A.: The Staining of Treponema Pallidum in Dry Smears, J. Lab. & Clin. Med. **9**:273 (Jan.) 1924.

37. Wile, U. J., and Kirchner, A.: A New Method for the Demonstration of the Spirochaeta Pallida in the Spinal Fluid, Arch. Dermat. & Syph. **8**:831 (Dec.) 1923.

38. Slodin, M., and Lesser, F.: Beobachtungen am Reizserum Syphilitischer Saüglinger, Deutsche med. Wchnschr. **51**:1817 (Oct. 30) 1925.

39. Vulvoic, Lunbomir: Über die Frühdiagnosis der kongenitalen Syphilis bei der geburt durch Spirochätennachweis in der Nabelschnur, Klin. Wchnschr. **2**:2235 (Dec. 3) 1923.

40. Mebane, D. C.: Mongolian Idiocy with Teeth of Hutchinson's Type, Am. J. Dis. Child. **28**:438 (Oct.) 1924.

In one case, Stokes and Gardner [41] showed by means of the roentgen ray that the unerupted upper central incisors presented the conformation of Hutchinson teeth.

Langer and Wassmund [42] attribute the pathogenesis of Hutchinson teeth to syphilitic infection of the intermaxillary bone and the junction (symphysis) of the two sides of the jaw. The infection is similar to that occurring at an epiphysis. This explanation would account for the specificity of the typical tooth changes, and the limitation of these changes largely to the central incisor teeth.

MISCELLANEOUS

In a study under controlled conditions, Smith and Gill [43] found, as have others, that the luetin test is inadequate as a means of diagnosing or excluding syphilis.

Beretervides and Beretervides [44] assert that in patients with hereditary syphilis the aorta is always involved, as shown by the broader and heavier roentgen-ray shadow and a characteristic metallic second sound.

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41. Stokes, J. H., and Gardner, B. S.: The Demonstration of Unerupted Hutchinson's Teeth by Roentgen Ray, J. A. M. A. **80**:28 (Jan. 6) 1923.

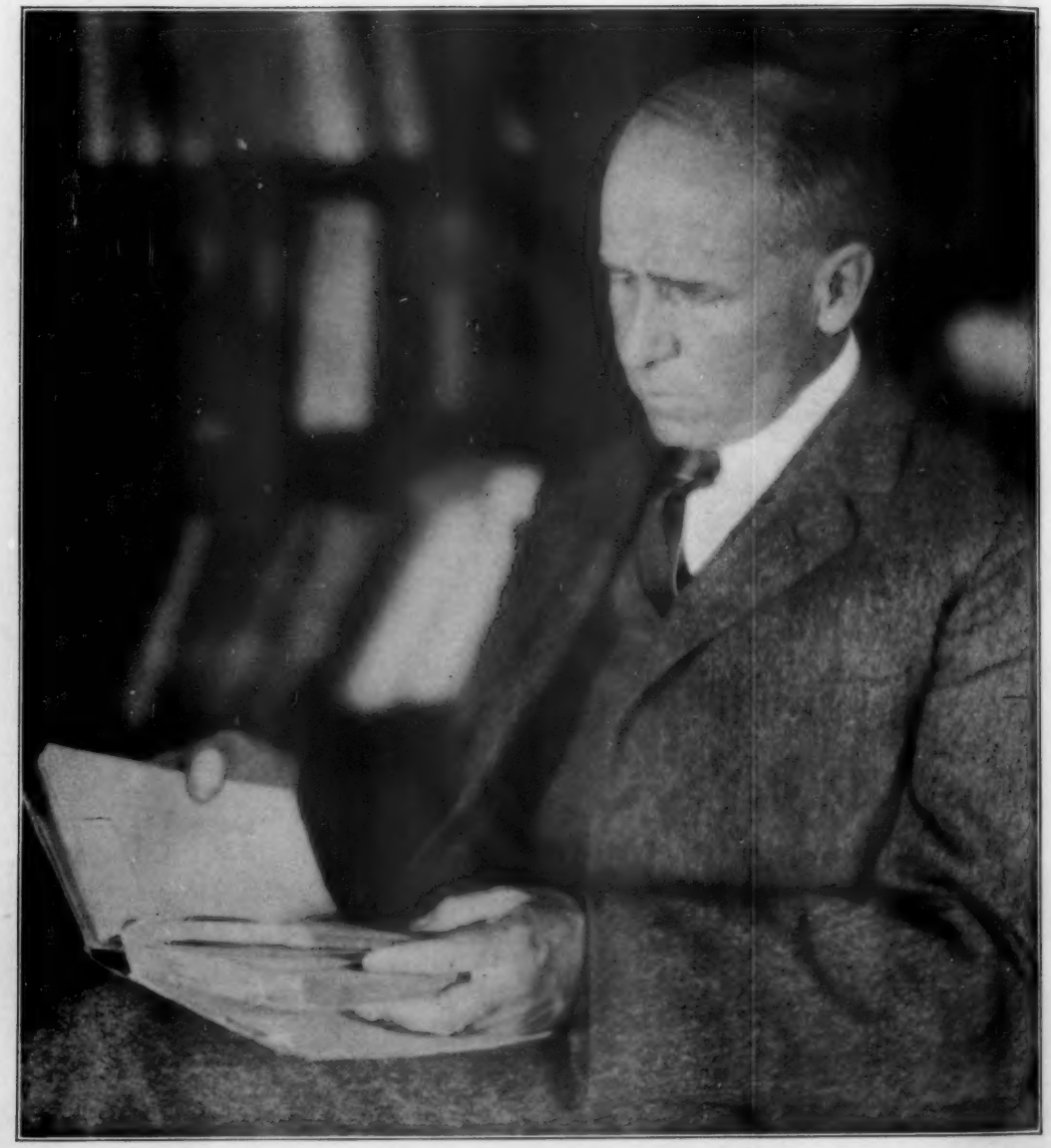
42. Langer, E., and Wassmund, M.: Teeth in Congenital Syphilis, Klin. Wchnschr. **4**:110 (Jan. 15) 1925.

43. Smith, D. C., and Gill, R. D.: Nonspecificity of Luetin Test, Am. J. Syph. **9**:292 (April) 1925.

44. Beretervides, A. E., and Beretervides, J. J.: The Aorta in Children, Arch. latino-am. de pediat. **19**:797 (May) 1925; abstr. J. A. M. A. **85**:1339 (Oct. 24) 1925.

(To be Continued)

UNIV. OF MICH.



JOHN HOWLAND, M.D.

1873-1926

OBITUARY

JOHN HOWLAND, M.D.

1873-1926

Dr. John Howland died June 20, 1926. No greater shock could have been felt by those who knew and loved him. He had suffered from hiccough for several days in February but, aside from weakness following this illness, he was in good health when he went to Europe on March 31, in accordance with plans made over a year ago. He visited several clinics abroad, and in his last letter sent from Paris on May 24, he wrote that he was perfectly well. According to the cablegrams which have been received, a cold from which he was suffering became worse on May 27, a severe cough developed which fatigued him greatly, and he had attacks of what was thought to be indigestion. His condition improved during the next two weeks, and he went to London on June 11. He arrived in an exhausted condition, and had two hemorrhages apparently of gastric origin. A tentative diagnosis of duodenal ulcer was made and as the bleeding continued, a laparotomy was performed on June 15. Marked cirrhosis of the liver was found, and that night his condition became critical. The next day the bleeding stopped and Dr. Howland rallied, but on June 18 he became delirious, coma developed the next day, and he died on Sunday, June 20. Mrs. Howland and Dr. and Mrs. James L. Gamble were with him.

Dr. Howland was born in New York, Feb. 3, 1873, the son of the late Judge Henry Elias Howland. He attended Phillips Exeter Academy, received his A.B. degree from Yale College in 1894, an M.D. from New York University College of Medicine in 1897, another M.D. from Cornell University in 1899 and an A.M. from Yale in 1914. He was a House Officer at the Presbyterian Hospital, New York, from 1897 to 1899, and at the New York Foundling Hospital from 1899 to 1900. During the Spanish War he was an army surgeon on the hospital ships which brought the troops suffering from typhoid fever from Cuba to New York. In 1900 he went abroad, and studied pathology and the diseases of children in Berlin and Vienna. On his return in 1902, he became associated with the late Dr. L. Emmett Holt in the practice of pediatrics. He was Pathologist and Assistant Attending Physician to the New York Foundling Hospital from 1902 to 1911, Pediatrician in Charge of the Children's Clinic, Belleview Hospital and Attending Physician to the Willard Parker Hospital from 1909 to 1911, and Instructor and Associate in Pediatrics at Columbia University from 1903 to 1911. In 1910 he was appointed Professor of Pediatrics at the Medical School of Washington University in St. Louis, and after several months of study at the Children's Clinic at Strasbourg assumed his duties in St. Louis in 1911. The following year he was called to the Johns Hopkins University School of Medicine. Here, through his clinical and scientific ability and his personality, he made the Harriet Lane Home an outstanding university pediatric clinic—a Mecca to which many came for training, and from which several have gone to take charge of children's clinics in other medical schools. During the Great War he served in the Medical Corps of the United States Army, and was engaged in the control of infectious diseases among the troops.

His written contributions to the study of the diseases of children began in 1904 with a pathologic study of dysentery and, during the following twenty-two years, have numbered over sixty articles on appendicitis, typhoid fever,

dysentery, indol and chloroform poisoning, pyloric stenosis, recurrent vomiting, status lymphaticus, diphtheria, infant feeding, nutrition, vaccines, metabolism, calorimetry, medical education, pneumonia, diarrhea, nephritis, cardiac disease, the exanthemas, endocrine therapy, acidosis, tetany and rickets. His investigations of the last three conditions have been of the greatest importance in establishing means for their prevention and cure. He and Doctor Holt collaborated in the seventh and eighth editions of "The Diseases of Infancy and Childhood," and just before he sailed for Europe, he completely revised this textbook for the ninth edition.

Dr. Howland was a member of the Board of Scientific Directors of the Rockefeller Foundation for Medical Research; of the Council on Pharmacy and Chemistry of the American Medical Association; of the American Pediatric Society; of the New York Academy of Medicine; of the American Society for Clinical Investigation and of the Association of American Physicians.

On Oct. 12, 1903, Dr. Howland was married to Miss Susan M. Sanford of New Haven, Conn., who with four children, Katharine, John, Louise and Elihu, survive him.

To those of us who have been closely associated with Dr. Howland, the shock of his death is so great that we are stunned. As we see his wards and his laboratories, and contemplate his plans for the future, we cannot realize that he will no longer be here to teach, stimulate and encourage us. He was the life and inspiration of this clinic; arriving before nine in the morning and leaving after six at night to go home to study and write, he was a constant example of the fact that success is founded on hard work. The students enjoyed and profited from his clinics, for he always made them think and his spontaneous humor made the description of even the dullest details interesting. To his staff he was a continual help, ready to discuss any clinical, scientific or personal problem. His judgment and his rugged honesty could always be relied on, and his interest in the welfare of those with whom he came in contact was manifest in innumerable ways. In addition to medical students and his staff, his advice was sought by all those who were interested in pediatrics. He had the respect of everyone as a real man. His influence in medical education was great not only in this school but elsewhere. It can truly be said that he placed the teaching of pediatrics in this country on a university basis.

W. C. D.

News and Comment

PROHIBITION OF PACIFIERS

In order to combat the use of pacifiers in France, the House of Representatives passed a law forbidding their manufacture and sale, at its meeting, March 24, 1926. Doubt is expressed if the prohibition will prove effectual, as the commercial pacifiers will probably be replaced by homemade articles. For instance, women in French villages use a linen rag dipped in sweetened water. Similar sugar teats will probably be commonly improvised.

CONGRESS FOR PROTECTION OF CHILDHOOD

The Fifth International Congress for protection of Childhood and Motherhood took place in April in Madrid under the patronage of the king of Spain, with Prof. Martinez Vargas presiding. The meeting continued for five days, from April 4 to 8, 1926.

PERSONAL

Prof. L. Morquio has returned to Montevideo from his service as delegate to the Child Welfare Congress at Geneva from Uruguay, and as the representative of the American Institute del Nino. He also lectured in Nobecourt's service, Paris, on "Hydatid Cysts in Children's Lungs."

Dr. Paul Letondal, St. Justine Hospital, was awarded honorable mention in the recent competition of prize theses, at the Faculty of Medicine, Paris. His work was entitled "Contribution to the Study of Giant Colon in Children."

DEATHS ABROAD

José-Maria Maidagan of Rosario de Santa Fé in Argentina, professor of children's surgery and orthopedics, and chief physician in the Hospital Centenario.

Axel Johannessen, professor of the children's clinic at the Faculty of Oslo, author of numerous works on pediatrics.

Abstracts from Current Literature

Anatomy and Physiology

THE IODINE LEVEL IN THE BLOOD OF MAN. W. H. VEIL, München. med. Wchnschr. **72**:636-639, 1925.

The author used the Fellenberg Chatin method for the determination of iodine in the blood. It was determined both colorimetrically and by titration. In normal persons 0.013 mg. were found in summer (in accordance with Kendall) and 0.0083 mg. in winter. Sixty-five per cent is bound to protein and thirty-five per cent is inorganic. In simple goiter, there is a lack of iodine, with no summer or winter variation. Operative interference on the thyroid was followed by a fall in the iodine level of the blood. In hyperthyroidism, without treatment with quinine or digitalis, the iodine was increased. During menstruation, there is a rise in the iodine level, also in true cardiac tachycardia. Administration of iodine, epinephrine, methenamine and insulin similarly increased the iodine level. Administration of pilocarpin decreased it; cholin first decreased with a later increase. Digitalis acts similarly. In fever, the level is higher than normal.

GROB, Rochester, Minn.

OSMOTIC PRESSURE OF THE CEREBROSPINAL FLUID. JINZO KANEKO, J. Pediat. (Tokyo), No. 304, 116 (Sept.) 1925.

In order to explain the occurrence of some grave symptoms following the intraspinal injection of therapeutic agents, Kaneko experimented on the effect of various therapeutic serums by injecting them with both hypotonic and hypertonic solutions in the subarachnoid space in rabbits. When he used a hypertonic solution containing 0.3 per cent sodium chloride and 10 Gm. of glucose, he found no ill effects on the blood pressure, but when he used 2 per cent pure sodium chloride solution, he noted a gradual rise in blood pressure. This effect was thought to be due to the ionization of sodium, and this is prevented by the addition of nonelectrolytic glucose. When the author injected a hypotonic solution containing 0.3 per cent sodium chloride and 20.5 Gm. of glucose, he found that the blood pressure went down gradually, the same effect being noted also when a 0.3 per cent pure sodium chloride solution was used, and when only 2 Gm. of glucose alone was used. Thus it became clear that hypotonicity had no relation with the degree of ionization, but that the lowering of blood pressure was due to the changes in the osmotic pressure of the fluids injected. In the course of his experiments with various therapeutic serums, he finally found that the lowering of blood pressure following their use was due to the phenol content which is usually to the amount of 0.5 per cent.

PHYSIOLOGICAL VARIATION OF LEUKOCYTES DURING THE LAST STAGE OF PREGNANCY AND EARLY INFANCY. TAKEO YASHIO, J. Pediat. (Tokyo) No. 304, 143 (Sept.) 1925.

It is well known that the periods mentioned are characterized by a high leukocyte count, but the relationship between the polymorphonuclear neutrophils and the lymphocytes is worthy of special notice. In albino rats, the lymphocytes exceed the polymorphonuclears at two days before birth, and again drop below

the latter at five days after birth, indicating that birth is accompanied by a high lymphocytic count. In young chicks this relationship is not significant. It is to be observed that in chicks the cells which give positive reaction to oxidase and peroxidase stains are very few in number up until the third month after hatching, and they gradually increase in number thereafter.

EXPERIMENTAL STUDIES OF STARVATION. I. ACETONE VARIATION IN THE BLOOD OF STARVING ANIMALS. S. IZUMI and D. KUNISAKI, J. Pediat. (Tokyo), No. 304, 153 (Sept.) 1925.

Blood acetone was quantitatively measured daily in rabbits during the period of absolute starvation, the control animals having been given a small amount of water. In all cases, it was found that the acetone first increases soon after the beginning of the starvation period and rapidly decreases. Then there is a second increase followed again by a decrease just before death, which usually takes place on the twelfth or thirteenth day of starvation.

EXPERIMENTAL STUDIES OF STARVATION. II. VARIATION OF BLOOD SUGAR IN STARVATION. K. SUZAKI, J. Pediat. (Tokyo), No. 304, 157 (Sept.) 1925.

In the same experimental animals used by Izumi and Kunisaki in Study I, the author found that the reducing substance in the blood (Bang's old method) gradually decreases up to the fifth day of starvation, and then there is a slight increase and just prior to death there is a sudden fall. This reducing substance needs to be identified further.

EXPERIMENTAL STUDIES OF STARVATION. III. GLYCOGEN CONTENT IN STARVED ANIMALS. R. NISHIDA and S. IZUMI, J. Pediat. (Tokyo), 304, 159 (Sept.) 1925.

Quantitatively, the authors found that there was about 0.005 to 0.006 per cent of glycogen left in the liver substance of animals that died of starvation. This is practically an absence of this substance in such animals.

ETHER-EXTRACTIBLE ACIDITY OF URINE. Y. KOHARA and J. ONIZAWA, J. Pediat. Tokyo), No. 304, 162 (Sept.) 1925.

The authors determined quantitatively the amount of organic acid which can be converted into ether. In normal persons, the highest amount was 4.6, while the lowest was 1.8. The amount decreases after exercise in starved animals, and after feeding the animals with small amounts of hydrochloric acid. It is increased by giving excess of citric acid.

KATO, Los Angeles.

Pathology, Bacteriology and Biochemistry

STUDIES ON THE BIOLOGY OF THE STREPTOCOCCUS ERYSIPELATIS. III. EXPERIMENTAL PRODUCTION OF ERYSIPELAS IN RABBITS AND DEMONSTRATION OF PROTECTIVE POWER OF IMMUNE ERYSIPELAS SERA. KONRAD E. BIRKHAUG, Bull. Johns Hopkins Hosp. **37**:307, 1925.

The author summarizes his work as follows:

1. Intracutaneous inoculation of hemolytic streptococci isolated from human cases of erysipelas produced typical lesions similar to erysipelas in the skin of normal and susceptible rabbits. Three types of lesions were observed—

erythematous, diffuse and phlegmonous. The pathologic picture of the erythematous and diffuse lesions was similar in nature to that seen in erysipelas in human beings.

2. Intracutaneous infiltration of mixtures of immune erysipelas serum and hemolytic streptococci of erysipelas origin afforded local protection against the injurious action of the streptococci. Normal rabbit serum or immune erysipelas serum heated at 60 C. for thirty minutes failed to protect the skin against the harmful effects of the inoculated erysipelatous streptococci.

3. Intravenous or subcutaneous administration of large doses of immune erysipelas serum protected the animal against lethal doses of hemolytic streptococci isolated from erysipelas, when the serum was injected twenty-four hours before the bacterial inoculation. Normal rabbit serum or immune erysipelas serum heated at 60 C. for thirty minutes offered no protection against the lethal dose of erysipelas streptococci.

4. Immune erysipelas serum afforded no local or general protection against the harmful action of hemolytic streptococci isolated from nonerysipelas sources.

5. Intradermal infiltration of Dochez' antiscarlatinal serum produced the blanching phenomenon in the rash of 94 per cent of scarlet fever patients, whereas similar infiltration of antierysipelas serum failed to produce the blanching phenomenon in the rash of scarlet fever.

6. Intradermal, intravenous and intramuscular injections of large doses of immune erysipelas serum in cases of erysipelas seem to offer promise of the specific treatment of the disease.

LYTTLE, New York.

"PIN POINT COLONY" ORGANISMS IN THE BALTIMORE MILK SUPPLY. JOSEPH CHARLES SWENARTON, J. Bacteriol. **11**:285 (April) 1926.

A study of "pin point colonies," due to streptococci occurring on routine plates for milk control, indicates their greatest frequency in the months of January, February, March and April.

The possible relationship of these streptococci from "pin point colonies" to udder trouble, and the significance of these colonies as an indication of mastitis are discussed.

WESTLUND, Chicago.

A COLORIMETRIC METHOD FOR THE ESTIMATION OF BLOOD CALCIUM. JOSEPH H. ROE and BERNARD S. KAHN, J. Biol. Chem. **67**:585, 1926.

The authors present a method of determination of the blood calcium involving:

1. The precipitation and removal of the protein of the serum by trichloracetic acid.

2. The precipitation of the calcium in an alkaline solution as phosphate by trisodium phosphate.

3. Washing of the precipitate by faintly alkaline alcohol.

4. Dissolving the precipitate by sulphuric acid and determining the phosphate by the molybdic oxide colorimetric procedure.

The authors recommend using 2 cc. serum. They claim to get accurate results, and that the method is better adapted to smaller quantities of serum than other methods in use at the present time.

THE PHOSPHORUS CONTENT OF THE BODY IN RELATION TO AGE, GROWTH AND FOOD. H. C. SHERMAN and E. J. QUINN, J. Biol. Chem. **67**:667, 1926.

The bodies of a large number of normal white rats of various ages were analyzed quantitatively for phosphorus. The percentage phosphorus for different ages are as follows:

Age	Male, Per Cent.	Female, Per Cent.
Birth	0.34	0.34
15 days	0.49	0.49
28 days	0.53	0.56
61 days	0.57	0.65
91 days	0.62	0.68
120 days	0.65	0.69
Adult 250 days	0.68	0.74 and 0.66 *
500 days	0.71	0.75 *

* Females which had raised young.

The percentage of phosphorus is lower in the male than in the female. Females while bearing and suckling young have a lower percentage of phosphorus.

The percentage of calcium in rats shows a similar variation according to the age of the animal.

ON GLUTOSE AND ITS BIOCHEMICAL BEHAVIOR. ETHEL M. BENEDICT, H. D. DAKIN and R. WEST, J. Biol. Chem. **68**:1, 1926.

Glutose is a nonfermentable ketohexose, formed by the action of alkali on glucose or fructose. The authors describe a method of preparation and some chemical reactions of glutose. Biologic tests were made with the following results:

1. The tolerance by the human organism is very low; it is excreted in the urine and by bowel. Large doses lead to diarrhea. The respiratory quotient following ingestion of 100 grams of glutose was unchanged both in a normal subject and in a diabetic subject.

2. Glutose ingestion did not affect the dextrose-nitrogen ratio in phlorhidinized dogs.

3. Acetone-body excretion was unaffected in one case, increased in two cases and diminished in one case, when glutose was fed to persons on a ketogenic diet.

4. Glutose ingestion did not influence the glucose excretion of a diabetic subject.

THE MINIMUM ENDOGENOUS NITROGEN METABOLISM. MILLARD SMITH, J. Biol. Chem. **68**:15, 1926.

The author studied the nitrogen metabolism of a healthy active medical student on a diet which was essentially protein free. The experiment consisted of seven days of unrestricted diet, twenty-four days of nonprotein diet, followed by three days of unrestricted diet. The nitrogen excretion in the urine (indicating the endogenous nitrogen metabolism) on the last day of the diet period was 1.58 Gm., of which 22 per cent was as urea, 14 per cent as ammonia, 35 per cent as creatinine and 7 per cent as uric acid. This figure (1.58) is lower than any found in the literature.

The diet consisted of approximately 2 Gm. protein, 100 Gm. fat, and 560 Gm. carbohydrate, and 3,167 calories per day. Considerable experimenting was necessary to produce a palatable nonprotein diet.

The subject of the experiment suffered no harm from the diet. For the twenty-four days, the total nitrogen lost was 80.08 Gm., a negative nitrogen balance of 3.34 Gm. per day.

HIGGINS, Cincinnati.

CHEMISTRY OF THE INTESTINAL FLORA OF NURSLINGS. A. I. KENDALL, A. A. DAY and A. W. WALKER, J. Infect. Dis. **38**:200 (March) 1926.

The nitrogenous metabolism of the mixed intestinal flora of a series of twelve normal nurslings shows that the nitrogenous changes induced by the microbes are relatively little. Proteolysis of bacterial origin is minimal.

The striking change induced by the mixed flora is a pronounced fermentation of utilizable carbohydrates, particularly glucose and lactose. In these mediums, there is a rapid and intense formation of acid, with almost no indication of nitrogenous change in the constituents of the medium other than those ultimately associated with the anabolic phase of bacterial activity.

This pronounced fermentation (principally lactic) is characteristic of the chemistry of the combined fecal bacteria of nurslings.

CHEMISTRY OF THE INTESTINAL BACTERIA OF ARTIFICIALLY FED INFANTS. A. I. KENDALL, A. A. DAY and A. W. WALKER, J. Infect. Dis. **38**:205 (March) 1926.

The analyses of the composite changes induced in suitable cultural mediums by the intestinal floras of artificially fed infants reported are representative for the small series studied. They do not necessarily typify those that might be encountered in other similar groups. Hence, they are to be considered as suggestive rather than definitive.

The outstanding feature centers around the striking difference between the nitrogenous metabolism of the floras in plain sugar-free mediums and in carbohydrate-enriched mediums, respectively.

In the former, the nitrogenous constituents are rather profoundly degraded, and the microbes utilize the products of degradation-polypeptids, apparently, for energy as well as for structure.

The addition of utilizable carbohydrate to such mediums, prior to the infection with the intestinal organisms, shifts the catabolism of the bacteria from protein to carbohydrate. This is indicated both by the very slight changes detectable in the nitrogenous constituents of the mediums containing carbohydrate, and also by the rapid accumulation of acid. Stated differently, the intestinal floras of artificially fed children induce putrefactive changes in sugar-free mediums, and fermentative changes in the same mediums to which carbohydrates have been added.

It must be remembered that the effects of supplying utilizable sugars to the intestinal organisms, which are so strikingly brought out in the accompanying tables, are those induced in test tubes, outside the intestinal environment. It is very probable, however, that parallel changes would take place within the alimentary canal, provided utilizable carbohydrate could be kept continuously at levels of the intestinal tract at which proteolysis would otherwise take place.

BACTERIAL FLORA AND HYDROGEN ION CONCENTRATION OF DUODENUM. FLOYD ARNOLD AND LOUIS BRODY, J. Infect. Dis. **38**:249 (March) 1926.

When the normal reaction of the contents of the duodenum and upper jejunum is changed from a slightly acid (p_H 5 to 6) to a neutral or alkaline reaction (p_H 7 to 8), there is a change in the bacterial flora of this region.

When the contents of the duodenum and upper jejunum are neutral or alkaline in reaction, the bacterial flora resembles that found in the ileum and cecum. The normal duodenal flora is not changed by tying off the pancreatic ducts.

The maintenance of the normal hydrogen ion concentration of the contents of the duodenum and upper jejunum is dependent to a great extent on normal gastric secretory function.

KENNEDY, Rochester, Minn.

PATHOGENESIS OF A VIBRIO SIMILAR TO THAT OF CHOLERA. A. ASCIONE, Ann. d'ig. **26**:1-23, 1926.

In 1922, the author isolated a vibrio from well water, and conducted a series of experiments on guinea-pigs to determine its pathogenesis. It resembles the cholera vibrio morphologically, culturally and biochemically; it is not, however, agglutinable by anticholera serums. Injected into the peritoneal cavity of the guinea-pig, in lethal and in sublethal doses, it passed into the blood stream by way of the lymphatics and became localized in the intestines. In some animals lesions were produced, and in others the organism was expelled through the alimentary canal. The vibrio showed definite enterotropism. The pathologic changes observed postmortem resembled very strikingly those caused by the true cholera vibrio as described by Sanarelli. The intestinal mucosa was very hyperemic and the bowel contents were diarrheic. The peritoneum showed marked cellular reaction and infiltration. The lymphatic patches in the ileum were densely infiltrated with lymphocytes; the epithelial and glandular structures were in various stages of degeneration. The vibrios were found intracellularly and extracellularly. Cultures on agar from the peritoneal exudates and intestinal lesions showed many colonies of the organism. In a few animals pure blood cultures were obtained.

EXPERIMENTAL ENCEPHALITIS FROM MOLDS. F. LOMBARDO, Ann. d'ig. **26**:31-35, 1926.

An emulsion, in physiologic sodium chloride solution, of *Aspergillus niger* and *fumigatus* was injected into the subdural space of rabbits and guinea-pigs. The incubation period was presumably very short, and the animals died on the fifth and sixth days following inoculation, presenting a classical clinical picture of encephalitis. Convulsions occurred on the third day, and were followed in most cases by spastic hemiplegia. Some animals died on the third day, showing signs of a general paralysis. Cultures made from the brain substance yielded a few colonies of the injected mold. Inoculations from one animal to another were unsuccessful.

Animals dying within forty-eight hours with very acute manifestations showed small circumscribed foci of encephalitis in the midbrain, around Ammon's horn. These areas consisted of accumulations of lymphocytes, the mononuclear variety predominating; there were a few polymorphonuclear leukocytes. Most of the lesions were located at the junction of the white and gray matter. Spores of the molds appeared as yellowish bodies around and in the center of the cell groups. A few spores were seen in the lumen of the small blood vessels. In the subacute cases, the lesions occurred in the nerve tissue proper. The encephalitic areas showed homogenization and the cells had a lessened affinity for stains. Scattered throughout the neuroglia tissue were clumps of mononuclear cells. Emulsions of the same molds, heated to 70 C. for forty-five minutes, failed to reproduce the disease when injected into animals.

ZAMBARANO, Northville, Mich.

THE CHANGES IN BEHAVIOR OF THE STREPTOCOCCI. R. HUBERT, München. med. Wchnschr. **72**:643-645, 1925.

In four cases of sepsis due to *Streptococcus hemolyticus*, streptococci were taken from two living patients and from two patients after death. When inoculated into mice intraperitoneally, they behaved differently. In culture, only pure hemolytic chains were recovered in all four cases. Through animal passage (mice) these changed to green producing streptococci. In a few instances, in subcultures, they regained their hemolytic properties.

GROB, Rochester, Minn.

INVESTIGATIONS ON THE DISTRIBUTION OF GLUCOSE BETWEEN PLASMA AND ERYTHROCYTES IN NORMAL INDIVIDUALS AND PATIENTS WITH DIABETES MELLITUS. S. A. HOLBØL and E. FOCK, Ugesk. f. Læger. **49**:1073, 1925.

The ratio of the dextrose content in normal blood between the erythrocytes and plasma is 70: 100, and it is approximately the same in blood from patients with diabetes mellitus.

This ratio, which is designated by $\frac{B}{P}$, increases one to three hours after injection of glucose both in a normal and in a diabetic person. It is suggested by the author that this increase of the ratio is due: (1) to the diffusion of glucose into the tissue from the tissue capillaries or through the kidney capillaries, and (2) to a lag, a measurable period of time, in the diffusion of sugar from the cells into the plasma. These findings in vivo were confirmed by dialysis experiments in vitro.

PRESERVATION OF PROCAINE-SUPRARENIN SOLUTIONS. L. E. WALBUM, Ugesk. f. Læger. **50**:1106, 1925.

The author has demonstrated that sodium bisulphite, 0.2 per cent, does not prevent destruction of the procaine-suprarenin solutions in ampules, but that high acidity and a 0.1 per cent solution of chinosol will prevent any material change over a period of eighteen months.

SCHLUTZ, Minneapolis.

RELATIONS OF BLOOD CATALASE TO THE NUMBER OF RETICULATED ERYTHROCYTES IN EXPERIMENTAL ANEMIA. M. NOZAKI, J. Pediat. (Tokyo), No. 304, 123 (Sept.) 1925.

The author produced anemia experimentally by daily bleeding and daily injection of 0.05 to 0.08 Gm. per kilogram of body weight in rabbits, and studied the amount of blood catalase and the number of reticulated red cells. He found that the reticulated cells first increase in number, whereas the erythrocytes and blood catalase decrease in number and amount. There is a similarity in the curves of reticulated erythrocytes and the catalase index (the ratio of catalase number to the number of a million erythrocytes).

CONCERNING MY PARADYSENTERY BACILLI. K. MITA, J. Pediat. (Tokyo), No. 304, 126 (Sept.) 1925.

Several years ago, the author published the results of his observations and bacteriologic study of an independent group of organisms isolated from the intestines of the patients who were suffering from a mild form of intestinal infection resembling dysentery. A further study on the subject has led the author to state that this organism cannot be classed with the dysentery group,

although some of his critics insisted that it is a variety of dysentery bacillus, on the ground that it sometimes can be agglutinated by the immune serum of dysentery, especially if the cultures are old. Some critics have again insisted that this organism is a variety of colon bacillus, but that is true of dysentery and all other intestinal bacteria. The paradysentery bacilli can also be differentiated into para-A and para-B types, the difference being based on the fermentation of six sugars. The toxicity of this group of bacilli is much less than that of the dysentery bacillus.

ONE COURSE OF CHEMICAL CHANGE OF HISTIDINE IN DOGS. M. KONISHI, J. Pediat. (Tokyo), No. 304, 150 (Sept.) 1925.

The author found that by feeding a large amount of histidine to dogs, a fine crystalline body could be recovered in the urine. This crytalline body has a melting point of 218 to 220 C., and possesses a pearl-like luster. On analysis and from various chemical reactions, this substance was found to be urocaninic acid, which is an unsaturated acid, formed in the body as intermediate products, not of alpha-oxidation, but of beta-oxidation, a fact which has not been known before.

KATO, Los Angeles.

Nutrition

SOME RECENT ASPECTS OF NUTRITION WITH REFERENCE TO PEDIATRICS. V. E. LEVINE, Arch. Pediat. **42**:767, 1925.

We have now come to realize that lowered gastric acidity in the adult, and especially in the infant and child, is an abnormality that needs immediate correction. The physiologic disadvantages of such a condition are many. In such specific diseases as rickets and tetany and in the presence of infection there exists a lowered gastric acidity.

RICKETS IN COLORADO. R. P. FORBES, B. GREEN and F. B. STEPHENSON, Arch. Pediat. **43**:131, 1926.

The comparative incidence of rickets in Colorado is low, and the cases are usually mild. Active rickets usually occurs under 1 year of age. Rachitic deformities are seldom seen because rickets is rare at the age when deformities usually appear. Negro and Mexican babies show a high incidence of rickets, but Italian babies compare favorably with the American group. Most babies examined were found to be sleeping out of doors in the winter months, and those having bright nurseries were less apt to develop rickets than those kept in dark nurseries.

The comparatively low incidence of rickets in Colorado may be attributed to the high percentage of actinic rays reaching the earth at high altitudes (about 43 per cent more at Denver than at sea level), to the higher percentage of winter sunshine and the low humidity and to a relatively high day temperature, allowing infants to sleep out of doors in the winter months.

VON MEYSENBUG, New Orleans.

STUDIES OF CERTAIN HITHERTO UNDESCRIBED ANTIRACHITIC SUBSTANCES. ANDOR DE BOSANYI, Bull. Johns Hopkins Hosp. **38**:72, 1926.

De Bosanyi finds that hemoglobin in amounts of 5 to 6 per cent by weight of the diet will prevent and cure rickets. The action is due to the globin faction

of hemoglobin. He also found that cystine, epinephrine and pilocarpine, not usually recognized as antirachitic substances, would induce healing of rickets.

LYTTLE, New York.

ANTIRACHITIC SUBSTANCES. III. THE CATALYTIC FORMATION OF AN ANTIRACHITIC CHOLESTEROL DERIVATIVE. CHARLES E. BILLS, J. Biol. Chem. **67**:753, 1926.

Cholesterol dissolved in carbon tetrachloride was mixed with floridin and the mixture heated, using a reflex condenser. Floridin is a fullers' earth obtained from a mine in Florida. The cholesterol was found to be polymerized by this treatment, the floridin acting as a catalyst. The resulting product was tested biologically and found to be antirachitic. When other solvents, as xylene, toluene and benzene were used, a similar change in the cholesterol occurred; but when ethyl acetate, ethyl alcohol, n-propyl alcohol, and isobutyl alcohol were used, the reaction did not take place. The chemical change occurring in the cholesterol will be discussed in a later report.

A QUANTITATIVE STUDY OF THE STORAGE OF VITAMIN A. H. C. SHERMAN and M. L. CAMMACK, J. Biol. Chem. **68**:69, 1926.

The survival period of rats, following the giving of a diet containing no vitamin A, indicates the store of vitamin A in their bodies. The storage of vitamin A depends on the quantity in the food and the length of time over which it has been given. The accumulation of vitamin A in the rat is rapid at first, but becomes slower as the maximum possible store is approached.

HIGGINS, Cincinnati.

A PLAN TO SECURE THE UNIFICATION OF MILK CONTROL IN THE UNITED STATES. L. C. FRANK, Pub. Health Bull. No. 161, Treasury Department, p. 26.

So far, eight states and fifty cities of the United States have a standard milk sanitation program. Investigations show a much greater prevalence of milk borne disease now than a few years ago. Very few communities of the United States have efficient or standard milk requirements, and the dairy industries have little respect for health officers because of this lack of efficiency and standardization. The public, as a result, does not consume as much milk as it otherwise would.

It is suggested to have a committee on milk control created, composed of state and territorial health officers working with representatives from the dairy division of the United States Department of Agriculture and the United States Public Health Department. This committee would investigate the standard most universally used at the present, and modify it to meet the national demand. Their work should be made progressive by future changes of the standard, suggestions for which would be made by the various state health officers at their annual meetings and voted on by the body as a whole. Periodic measure of the progress accomplished should be made.

BARNETT, Chicago.

THE PHANTOM OF CRANIOTABES. JULES COMBY, Arch. de méd. d. enf. **29**:73 (Feb.) 1926.

Craniotabes was first described in 1843 by Elsasser of Stuttgart, who designated the condition as "weiche Hinterkopf," a retardation of calcification or

an actual decalcification of certain portions of the cranial box. In England, it became known as the soft occiput and in France as craniomalacia or craniotabes, the latter term now being generally accepted. This phenomenon, while ordinarily affecting the occipital bones, may also be found in the parietal and the temporal regions, always, however, excluding the frontals.

Elsasser attempted to prove that craniotabes was a grave disorder of infants, responsible directly for the chain of symptoms now grouped under the syndrome known as spasmophilia. He was reinforced in these conclusions by the observations of Kassowitz. Comby believes it essential that we divest our deliberations from this error, and calls attention to the cases of craniotabes seen daily in every large clinic, unassociated with laryngospasm or other signs of spasmophilia, as well as to other classical cases of the latter quite free from any manifestation of craniotabes. He feels that we should separate the conditions entirely in the light of abundant evidence that they are in no way related.

There remains the rôle of rickets and of hereditary syphilis to be considered. For the latter, he agrees wholly with the American investigators, Barenberg and Bloomberg, who found no connection whatever between congenital syphilis and craniotabes. As to rickets, the relation of these two diseases is not so easily determined. The American investigators, before cited, found that among 289 infants, 44.6 per cent showed craniotabes. More recently, Wilson and Seldowitz report in this Journal, for May, 1925, among 469 infants, 164 cases of craniotabes, of whom but 121 showed evidences of rickets. They conclude that craniotabes is an independent lesion, having no bearing on either syphilis or rickets. The most one can safely admit is to accept the term cranial rickets as possibly interchangeable with craniotabes. Comby believes his observations justify the assertion that craniotabes has no great significance, whatever its origin may be, and quotes twenty cases in defense of this contention.

AMESSE, Denver.

VARIATIONS IN METABOLISM IN STATES OF UNDERNUTRITION AND DEBILITY IN INFANCY. A. FOUET, Rev. franç. de pediat. **1**:183, 1925.

Satisfactory determinations of the basal metabolism (thirty-eight in all) were made on twenty-two infants, varying in age from 15 days to 16 months. Eight were considered as cases of congenital debility; the others, born at term with normal weight, were almost all atrophic or athreptic.

It was found that until the weight deficit (that is, the difference between the actual weight of the infant and the weight of a normal infant of the same age) reaches a certain figure, the basal metabolism (expressed in calories per twenty-four hours) remains invariable. When, however, the weight deficit exceeded 35 to 38 per cent of the normal weight, the basal metabolism (calories per twenty-four hours) falls rapidly to a figure far below normal. The author suggests that it is at this point that the tearing down of tissues reaches the viscera, and the fall in basal metabolism reflects a functional deficiency. The condition is characterized by a modification of the physicochemical equilibrium of the protoplasm, and a reduction of the power of assimilation. This offers a physiologic basis for the clinical observation that death supervenes when the weight falls as far as 40 per cent below normal.

Contrasted with cases of true debility, premature infants, otherwise normal, do not show any decrease in basal metabolism.

LESLIE, Chicago.

STUDIES ON TRYPSIN, ESPECIALLY IN RACHITIC INFANTS. J. VON LUKACS, Monatschr. f. Kinderh. **31**:507, 1926.

In 1914, McClure and Chancellor showed that in florid rickets there was an increased output of amylase in the urine. Later, Hizume found an increased output of lipase in the stool. The writer now investigated the third pancreas ferment, namely, trypsin. His work was done on the protease content of the stool.

There is no question but that the rachitic stool contains more protease than the normal, an increase of four to ten times. There is, however, no definite relation between the amount of the excretion and the severity of the disease. This increase becomes apparent before the onset of the clinical symptoms.

In infections the rachitic child reacts as does the nonrachitic one with a decreased protease excretion, but in the rachitic the excretion never diminishes to the same degree as in the normal.

GERSTLEY, Chicago.

CHANGES IN THE HEART PRODUCED BY THE ADDITION OF COD LIVER OIL IN THE DIET. ERIK AGDUHR, Acta Pædiat. **5**:319, 1926.

Most of these experiments were performed on white mice. The author finds that 0.1 cc. of cod liver oil a day added to the diet of a mouse in time will produce exophthalmos, general anasarca and certain definite changes in the heart. The changes described are: pigment atrophy, albuminous and hyaline degeneration of the muscle cells (with replacement by connective tissue), hemorrhages and minute cell infiltrations. There are also found beneath the endocardium certain peculiar tumor-like formations, which the author designates as "thrombs."

A small number of experiments have been carried out on rats, cats, dogs and calves, which indicate that these animals are fully as susceptible as mice, if not more so. The toxic substance has not been isolated from the oil, but it can be entirely separated from the fraction containing the vitamin. The author calls attention to the fact that Mellanby has noted cardiac symptoms in man (tachycardia, precordial discomfort) after unusually large doses of cod liver oil. Agduhr is inclined to believe that prolonged dosage of infants with cod liver oil may favor the development of cardiac disease in later life.

THE EFFECT OF INJECTIONS OF MATERNAL SERUM ON THE RESISTANCE OF THE CHILD TOWARD INFECTIONS. I. JUNDELL, Acta. Pædiat. **5**:411, 1926.

Immunity toward infections in the first few months of life is a well known phenomenon, and is presumably due to antibodies received from the mother. Jundell attempted to increase the resistance of infants to infections during the remainder of the first year of life by subcutaneous injections of maternal serum. Fifty children were so treated on one or two occasions. The dose varied from 10 to 40 cc. No evidence was obtained that infections were reduced either in their incidence or in their duration.

HOLT, Baltimore.

LIGHT AND THE A-FACTOR. (II). C. E. BLOCH, Ugesk. f. Læger. **52**:1183, 1925.

The treatment of two children (brother and sister) suffering from xerophthalmia is reported.

The author comes to the conclusion that neither ultraviolet light nor sunlight is efficacious in the treatment of this disease, in that light can neither replace nor cause the formation of the A-factor in the body.

SCHLUTZ, Minneapolis.

THE NATURE OF THE SO-CALLED BREAST-MILK INTOXICATION. M. ISOBE, J. Pediat. (Tokyo), No. 304, 136 (Sept.) 1925.

It is difficult to compare the presence or absence of vitamin B in various kinds of milk, but, using the polished rice water, the author experimented on pigeons, and found that the intoxication produced by breast milk which is deficient in vitamin B is practically and clinically identical with the beriberi in the nursing infants, and both are due to the absence of vitamin B.

KATO, Los Angeles.

Prenatal Conditions

SPONTANEOUS INTRA-UTERINE AMPUTATIONS. JOHN STEPHENS LATTA, Am. J. Obst. & Gynec. **10**:640, 1925.

The author reports a case of intra-uterine amputation in one of identical twins, and reviews the literature concerning the case reports and causes of this condition.

In his case, the twins were stillborn. In one there was no apparent pathologic condition, but in the other the constricting bands of amniotic tissue had caused deformities illustrating the different stages of amputation. The left leg just below the knee and the three toes on the right foot had been completely amputated. The right hand was nearly separated from the wrist and showed marked gross and microscopic evidence of venous and lymph stasis. The band of tissue on the left forearm had just begun the amputating process.

The bands were nonvascular, embryonal connective tissue similar to the rest of the amnion, and did not show evidence of inflammatory change. The author explains them as bands formed by vacuolization of the ectodermal portion of the inner cell mass when the amniotic cavity was formed.

ALLEN, Chicago.

CONGENITAL DUODENAL SEPTUM WITH OBSTRUCTION. S. M. SEIDLIN, Bull. Johns Hopkins Hosp. **37**:328, 1925.

At necropsy, the duodenum was larger than the stomach, with a diameter of 8 cm., and was found to be divided into two parts by a septum stretched across the lumen about 10 cm. above the jejunal flexure, and 10.5 cm. from the pylorus along the "lesser curvature" of the duodenum. The septum was dome shaped with an eccentrically placed opening 7 mm. in diameter.

The child was 2½ years old, the oldest patient on record with this type of anomaly. The ingestion of coarse food produced the acute obstruction at the orifice which caused death.

There is a good review of the literature.

LYTTLE, New York.

THE TWIN SISTERS — ANNA-MARIA SCHWARTZ. A. STRASSBURG MONSTER FROM THE YEAR 1606. ALFRED REH, Schweiz. med. Wchnschr. **56**:324 (April 10) 1926.

In the municipal archives of Strassburg there is a manuscript entitled: "Miscellanea Clussratti Cod. 850," a record by the Stad archivaris (Municipal Master of the Rolls) Laurentz Clussrath. The original text reads as follows:

"No. 13. A part of Strassburg Chronic, Laurentz Clussrath.

"*Monster.*—Anno 1606, Thursday the 2nd of Januarii, therefore with the beginning of the new year, there was born into the world a peculiar child here in Strassburg at one o'clock at night to a good, pious honest man, well known to me, Mr. Steffan Schwartz, a carpenter.

Wahre vnd eigentliche abcontersetung eines
kindes geborn zu Strasburg am 3 January
1606 dess nachts nach 12 vhr beim spittal
thor neben dem gulden apffell, daruon der
Vatter ein schreyner Steffan Schwartz genāt
die mutter Anna. vnd so ess beyde weibs sins
gewesen, ist ess Anna Marie getaufft
hatt nur ein antlitz 4. Ohren ein Hertz
1. Lung 2. Leber. vnd gelebt ½ Stundt

"It had two complete bodies and only one head. The head, according to such a new-born, was proportionately larger than two might have been. In the middle is a fine pleasing countenance. It has four ears. From the head downward to the soles of the feet there are two complete bodies, with arms, hands, abdomens, feet and all members to be distinguished from each other. The bodies were somewhat grown together, and if the one is lying on its back the other lies on its left side turned toward it. Though grown together they put their arms around each other. They were two daughters, came into the world and received the emergency baptism by the midwife, then carried into the general room and viewed, Friday the 3rd Januarii anno 1606."

This is a real and precise reproduction of an infant born at Strassburg on Jan. 3, 1606, after 12 o'clock midnight, at the Hospital Gate next to the Golden Apple, where the father was a carpenter named Steffan Schwartz. The mother was called Anna, and since both the babies were females they were baptized Anna-Maria. This monster had only one face, 4 ears, 1 heart, 1 lung, 2 livers, and lived for fifteen minutes.

ELTERICH, JR., Pittsburgh.

A CASE OF ARTERIOMESENTERIAL-DUODENAL CONSTRICTION IN INFANT. K. IWAKAWA, J. Pediat. (Tokyo), No. 304, 181 (Sept.) 1925.

Acute cases have been reported, but the case under discussion is a chronic one. The infant was 1 month old, first born, of healthy parents, breast fed, weighing 3,300 Gm., who was brought to the author with the complaint of persisting icterus, frequent malaise, prostration during or soon after nursing, slight malnutrition, passage of one or two foamy soft stools each day. There was occasional vomiting and in the vomitus was seen yellow bile. On examination of the abdomen, there was a clear cut gastric peristalsis with slight bulging of epigastrium, while the lower part of the abdomen was sunken. No tumor mass or resistance of the recti muscle was noted. Duodenal stricture was suspected, and an exploratory operation was done the same day, at which it was noted that the stomach was greatly distended with gas. There seemed to be no difficulty in the passage of intestinal contents from one part to another. Thus the gastric puncture was done to relieve the distention of the stomach, and the abdominal wound was sutured. The patient apparently did well after the operation, but peritonitis set in and death occurred two weeks afterward. Necropsy brought out the fact that there was a contraction of the mesocolon and the duodenum just below the ampulla of Vater which was constricted with yellowish discoloration. The author concludes that this pathologic condition may occur in an infant of this age, and that in the diagnosis of diseases resembling pyloric stenosis and pylorospasm, this form of intestinal pathology should be borne in mind. The most effective method of treatment seemed to be to place the patient on the abdomen and resort to frequent gastric lavage. An operation should be performed with much care.

KATO, Los Angeles.

Diseases of the New-Born

TREATMENT OF THE UMBILICAL CORD BY SHORT LIGATION AND USE OF CLAMP. JOHN F. DICKS, Am. J. Obst. & Gynec. **10**:707, 1925.

Much better results were reported by Dr. Dicks on his service, by employing the close ligation of the cord with the Martinez clamp to prevent cord infection.

ALLEN, Chicago.

SURGICAL TREATMENT OF INTRACRANIAL HEMORRHAGE IN THE NEW-BORN. WILLIAM O. OTT, Texas State J. Med. **12**:721 (April) 1926.

Contrary to the view formerly held, cerebral hemorrhage occurs frequently in perfectly normal deliveries, but, of course, more often in abnormal and instrumental cases. Conditions such as asphyxia, blue babies, convulsions and refusal to nurse in the new-born are usually due to cerebral hemorrhage.

The hemorrhage may be supratentorial, infratentorial, or in the spinal cord or canal.

A lumbar puncture should be made in every new-born baby that does not act normally. The puncture should be repeated every six to twenty-four hours until the fluid returns clear and the symptoms subside.

The blood clotting time should be made and if found prolonged, 10 cc. of blood should be injected subcutaneously and repeated if necessary.

Should the symptoms not subside after repeated lumbar punctures and the injection of blood, surgery is indicated.

MOORE, Dallas.

Acute Infections

THE VALUE OF CONVALESCENTS' SERUM IN PROTECTION AGAINST VARICELLA. A. G. MITCHELL and S. F. RAVENEL, Arch. Pediat. **42**:709, 1925.

Varicella convalescents' serum has sufficient protective power against the disease to warrant its collection and use in prophylaxis in hospital wards and in institutions. It is probable that more than 4 cc. of serum should be injected intramuscularly. The protection afforded lasts apparently as long as fifty days. The serum may be kept as long as eleven months after collection.

ACUTE INFLAMMATORY DISEASES IN THE ABDOMEN IN CHILDREN. F. BEEKMAN, Arch. Pediat. **42**:782, 1925.

In children under 2 years of age, intestinal obstruction is more commonly found than intra-abdominal inflammatory lesions, while in children over the age of 2, the inflammatory lesions of the abdomen prevail. Acute appendicitis is accountable for the greatest number of cases of peritonitis; a differential diagnosis between appendicitis and so-called primary peritonitis is very difficult; acute mesenteric lymphadenitis is often mistaken for acute appendicitis. Pneumonia and even acute tonsillitis may be associated with abdominal symptoms which make diagnosis very difficult.

BACILLUS BRONCHISEPTICUS INFECTION IN A CHILD WITH SYMPTOMS OF PERTUSSIS. J. HOWARD BROWN, Bull. Johns Hopkins Hosp. **38**:147, 1926.

The source of the infection was a pet rabbit which had a slight diarrhea, snuffles and sneezed frequently. The incubation period was twelve days. The child had two or three severe paroxysms of coughing during the night with a well defined whoop, strongly suggestive of pertussis. There was no vomiting and no increase of temperature, and the symptoms lasted for about a month.

The child was told to cough on a chocolate blood plate and the organism was received in pure culture. It was also recovered from the nares of the rabbit. Complete bacteriologic data are given.

The author suggests that human infection with this organism may be more common than has been recognized, and that many supposed cases of pertussis are needlessly quarantined.

LYTTLE, New York.

A Case of Renal Sarcoma Showing Remarkable Improvement After Varicella. Donald Paterson, Proc. Royal Soc. Med. Section for the Study of Disease in Children **19**:5 (Nov.) 1925.

Paterson reported a case of a child, aged 4½ years, who was admitted to hospital with a history of constipation, periodic distention of the abdomen, loss of weight and for two years occasional vomiting. The abdomen was greatly distended. There were two palpable masses, one in the left iliac fossa, and one in the right lumbar iliac region. Under an anesthetic they were found to be hard and nodular, and attached to the posterior abdominal wall. A diagnosis of renal sarcoma was proposed. After becoming gradually worse, the child rapidly became much better, gaining 2¾ pounds (1 Kg.) in a week. Ten days later, a typical varicella eruption appeared. During the incubation period the improvement was very striking, the patient gaining 6 pounds (2.7 Kg.) in weight. The masses however, remained. The good effect proved to be transient, the child losing ground rapidly and the masses increasing in size. Death ensued, and at necropsy the diagnosis of renal sarcoma was confirmed.

Williamson, New Orleans.

Vaccine Therapy in Typhoid Fever of Children. Spyropoulos, Arch. de. méd. d. enf. **29**:150 (March) 1926.

This is a report of fifty cases of typhoid among children ranging in age from 2 to 15 years, in the pediatric clinic of the University of Athens, treated with antityphoid vaccines. The author cites the prevailing theories relative to the use of vaccines in this disease, and describes his own method of treatment. In the series of cases under discussion, he used autogenous vaccines exclusively and administered them intravenously. The dosage was regulated according to age:

From 2 to 4 years, 5 to 10 million
From 4 to 6 years, 10 to 15 million
From 6 to 8 years, 15 to 20 million
From 8 to 10 years, 20 to 25 million
From 10 to 15 years, 30 to 35 million

In thirty-two cases, a single injection was followed immediately by an amelioration of symptoms, a return to normal temperature and a prompt convalescence. In twelve cases the first inoculation, while manifestly yielding some benefit, did not appreciably shorten the duration of the disease. In four cases, one injection was attended with no alteration in the symptomatology, but a second injection, given two to four days later, effected a speedy cure. In two cases the results were entirely negative.

Spyropoulos maintains that the reaction of autogenous vaccines is not serious, and strongly advocates their use in typhoid of early life.

Amesse, Denver.

Concerning Koplik's Spots. Geza Petenyi, Monatschr. f. Kinderh. **31**:533, 1926.

Six cases are reported in which Koplik spots were present but the disease did not prove to be measles. The writer believes that Koplik spots are not pathognomonic of measles, but are of value in the diagnosis if used in connection with other symptoms.

GLANDULAR FEVER. FRANZ MUNDEL and JOH FRANZ, Monatschr. f. Kinderh. **31**:545, 1926.

This is a clinical report of five cases typical in every respect of Pfeiffer's glandular fever, with the exception that the liver and spleen were not enlarged.

The children were between 2 and 3 years of age. Nasopharyngitis was relatively mild, and was followed in twenty-four to forty-eight hours by the glandular enlargement. The blood findings were normal.

Of great significance to the authors was the observation that all the children were of the lymphatic type, or else showed florid rachitis. The authors believe the disease is not a definite clinical entity, but rather a certain type of reaction to an ordinary infection occurring in the child with a lymphatic constitution.

THE "WATCHFUL WAITING" METHOD OF TREATING DIPHTHERITIC STENOSIS OF THE LARYNX. E. BURGHARD, Monatschr. f. Kinderh. **31**:626, 1926.

So much criticism has been leveled at Schlossmann for his extremely conservative method of treating diphtheria of the larynx that Burghard, an assistant in the clinic, writes of the method in detail.

There is a double purpose in being conservative as regards surgical interference. First, it gives one time to be sure of the diagnosis. Second, it enables one to determine the extent of the involvement. If the process has extended down to the bronchi, operative interference is in vain.

Having definitely established the diagnosis of diphtheria (and this should be clinical as well as bacteriologic) one should determine the extent of the involvement. Diphtheria of the bronchi gives a history of five to fourteen days illness at home, with beginning asphyxia before admission to the clinic. The child is desperately sick with circulation greatly depressed. The color is characteristically a blue-gray. Respiration is characteristic of asphyxia, and the dyspnea is typically expiratory as well as inspiratory. The frequency of respiration helps the diagnosis, particularly if observed during sleep. A gradual increase in the rate suggests a descending process. If aphonia is slight in spite of severe dyspnea, the conclusion is that the process has left the larynx and is working its way downward. The degree of albuminuria is always an index of the severity of the diphtheritic process, and is never absent in these bronchial cases.

The essential of the treatment in addition to antitoxin is a narcotic to overcome restlessness. Ordinary circulatory stimulants are needed, and plenty of fresh air is an absolute essential.

Local treatment is of no use, and the only operative interference is tracheotomy. The indication for this operation, according to the writer, is little short of absolute asphyxia. He believes in delaying until the last minute; indeed until the child is practically unconscious. This saves the use of an anesthetic.

With this delaying policy, he believes that intubation is never indicated, and he claims to have cut the mortality in even the severest of his cases down to 10 per cent.

GERSTLEY, Chicago.

GONORRHEAL ARTHRITIS IN INFANTS. KURT WAHLBERG, München. med. Wchnschr. **72**:770-771, 1925.

Two cases of gonorrheal arthritis are discussed. One infant, aged 1 month, after positive smears from the eyes and nose were taken, developed a gonorrheal arthritis of the right knee; the other new-born infant, aged 17 days, developed

swelling of three joints. Gonococci were demonstrated in both smear and culture of the exudate from the knee. At the time of the appearance of the arthritis, the primary foci were negative for gonococci in both infants. Six months later the affected joints were freely movable.

GROB, Rochester, Minn.

RHEUMATIC FEVER WITH BRADYCARDIA. R. NORDGREN, Acta. Pædiat. **5**:456, 1926.

The patient, a boy aged 7 years, suffering from rheumatic fever, developed a very marked bradycardia which lasted for five weeks. Electrodiagrams failed to show any evidence of defective conduction. The author believes that reflex irritation through the vagus, arising from inflamed areas in the heart, was responsible for this phenomenon.

HOLT, Baltimore.

IMMUNIZATION AGAINST MEASLES WITH THE AID OF CONVALESCENT SERUM. M. SIGGAARD ANDERSEN and FERDINAND WULFF, Ugesk. f. Læger. **9**:216, 1926.

This is a report of eighty-nine children and two adults exposed to measles, who were treated with convalescent serum. The serum was obtained from convalescing patients on the seventh to the ninth day after the temperature became normal. The dosage of serum given was 5 cc. at 1 year of age, and 15 cc. at 3 years of age, intramuscularly. Immunity was obtained in 95 per cent of the individuals treated.

SCHLUTZ, Minneapolis.

COMPARATIVE STUDY OF THERAPEUTIC METHODS OF PERTUSSIS. H. SAITO and K. GONDO, J. Pediat. (Tokyo), No. 304, 133 (Sept.) 1925.

Studying the effects of various methods of treatment in whooping cough, the authors summarize from their observations on 303 cases that there is no specific remedy for the ailment, that the sensitized vaccine is superior to a heated one, that "coctoprecipitinogen" is superior to the sensitized vaccine, and that all these are most effective in early stage of the disease, while intramuscular ether is effective in the paroxysmal stage.

CLINICAL OBSERVATIONS ON MEASLES. M. OGATA, J. Pediat. (Tokyo), No. 304, 148 (Sept.) 1925.

Measles, which was prevalent in Osaka in the early part of the year, was characterized by a long prodromal period, varying from four to ten days. The Koplik spots were very indistinct or were absent in some cases. The eruption appears only for a day or two, and sometimes presents the appearance of some hemorrhagic diseases. The complications, especially otitis media and pneumonia, were very frequent, and there was 20 per cent mortality. This high mortality may have been due to the fact that the greatest number of patients were infants under 2 years of age, and that the epidemic was in the coldest months of the year.

KATO, Los Angeles.

Chronic Infections

SUDDEN DEATH DUE TO EXACERBATION OF LATENT SYPHILITIC MYOCARDITIS. A. S. WARTHIN, Am. J. Syph. **10**:1 (Jan.) 1926.

Warthin describes a new clinical and pathologic manifestation of cardiovascular syphilis. Decompensation develops without previous warning and the

patient usually dies in a short time. The majority of his eight patients died before they were seen by a physician. Pathologic examination shows active syphilitic lesions present, which present spirochetal infection and infiltration with polymorphonuclear leukocytes. It occurs in supposedly latent syphilis, either acquired or congenital.

PREGNANCIES AS A FACTOR IN THE PREVENTION OF NEUROSYPHILIS. H. C. SOLOMON, Am. J. Syph. **10**:96 (Jan.) 1926.

Solomon has reviewed the histories of 559 child-bearing syphilitic women, all over 30 years of age, with reference to the incidence of pregnancy. He finds the incidence of pregnancy to be lower in those with central nervous system involvement.

The explanation may be (*a*) neurosyphilitic women are less fertile than other syphilitic women because of a more severe infection, or because of being infected with a different type of organism, namely, a neurotropic strain; (*b*) women who become pregnant receive protection against the spirochete and its attack on the nervous system.

McBRIDE, Iowa City.

THE RÔLE OF THE MONOCYTE IN TUBERCULOSIS. R. S. CUNNINGHAM, F. R. SABIN, S. SUGIYAMA and J. A. KINDWALL, Bull. Johns Hopkins Hosp. **37**:231, 1925.

This paper is too elaborate to give an adequate abstract of it here.

As a new factor in the study of tuberculosis, the authors present the concept that it is a disease which affects primarily a single strain of cells, namely, the monocytes.

They analyze the relationship which exists between the monocytes of the blood and of the tissues, and the changes which occur, especially with regard to the monocytes, in the course of acute experimental tuberculosis.

They found that the effect of tuberculosis on the whole system of the monocytes is a profound one, and consists primarily in a marked overproduction of the diffusely scattered reticular cells which are the parent cells of monocytes. This reticular cell is also the parent form of all of the other white blood cells, so that the effect of the tubercle bacillus on this cell is definitely to force it toward the production of monocytes. In normal connective tissues, the markedly undifferentiated reticular cell exists only in small numbers, so that, for example, in a scraping from the freshly cut surface of a normal lung, only an occasional cell of this type will be found. At a certain stage in tuberculosis, representing some cycle in the reaction of the body to the disease, these reticular cells may be found in an infected area, such as the septums of a tuberculous lung, in such large sheets as to cover an entire field or more, under an oil-immersion lens.

LYTTLE, New York.

THE ADMINISTRATION OF VACCINE B. C. G. TO NEW-BORN INFANTS AS A PROTECTION AGAINST TUBERCULOSIS. THE RESULTS OF ITS USE FROM 1921 TO 1926. A. CALMETTE, G. GUERIN, L. NEGRE and R. BOQUET, with the collaboration of B. WIELL HALLE, WILBERT and TURPIN, Presse méd. **16**:241 (Feb. 24) 1926.

In an effort to protect children in tuberculous homes, Calmette and his associates at the Pasteur Institute have been inoculating new-born infants with attenuated living cultures of tubercle bacilli.

The vaccine, known as B. C. G., has been furnished to many physicians in different countries, and during the past years 8,000 children have been treated. The vaccine was administered either by mouth or by subcutaneous injection. No bad effects were noted. The mortality among these children was less than 2 per cent, as compared with a general mortality of 25 per cent in the first year of life among children in tuberculous homes in France.

FRAWLEY, Fresno, Calif.

ACTINOTHERAPY IN THE TUBERCULOUS INFANT. P. GAUTIER and R. PEYROT, Rev. Franç. de pediat. **1**:447-452, 1925.

The report comes from the "Clinique Infantile" of Geneva, Switzerland, in which, during the past two years, they have been able to follow many babies, who, during the first few months of life, present evident signs of tuberculosis, that is, stationary weight, capricious and poor appetite, variable temperature, pallor and positive cutaneous reactions. The grave prognosis and therapeutic difficulty attending these cases is well recognized, and the effort of the physician must be to prolong the life of the infant until he, himself, older and more resistent, can fight with better chances of success against his tuberculosis. The authors have found that these cases respond particularly well to ultra-violet light, the appetite and weight improving, and the temperature tending to remain normal. The exposures are given daily, starting with one minute, and increasing a minute a day until a duration of thirty to forty-five minutes is reached. Since using this method of treatment, no deaths have occurred among the tuberculous infants, with the exception of those brought in with tuberculous meningitis.

LESLIE, Chicago.

THE TREATMENT OF CONGENITAL SYPHILIS WITH BISMUTH. ANDREAS TÜDÖS, Jahrb. f. Kinderh. **108**:236, 1925.

One hundred and fifteen patients with congenital syphilis were treated with bismuth preparations. A 10 per cent suspension of dipotassium bismuth tartrate in oil, and a 10 per cent suspension of bismuth iodide in oil were used. From 0.5 to 2 cc., depending on the age, size and general condition of the child, was injected into the gluteal muscles twice a week. Careful observation of this group of patients led the author to the following conclusions:

1. Bismuth causes the clinical symptoms of syphilis to disappear quickly, though not quite as quickly as does arsphenamine.

2. Bismuth has no detrimental effect on the body tissue, but it seems advisable to watch the urine and take good care of the mouth during treatment.

3. The preparations used are from the standpoint of efficiency and painlessness, reliable and without objection.

4. As a spirochitocide, bismuth stands second only to arsphenamine.

5. The Wassermann reaction is influenced by bismuth in the majority of cases. When the Wassermann reaction has not been influenced by arsphenamine, bismuth is also unable to change it. At least the management of syphilis with bismuth marks an important forward step and makes the less efficient mercury injections superfluous. In bismuth we have a new and powerful weapon against congenital syphilis which can be used in treatment of infants and young children without harm.

PARMELEE, Chicago.

TREATMENT OF TUBERCULOUS MENINGITIS WITH OXYGEN INSUFFLATION. K. KLINKE, Monatschr. f. Kinderh. **31**:539, 1926.

The writer quotes Sharps, who claimed that he injected oxygen into the spinal canal of twelve patients with tuberculous meningitis and that three recovered. These treatments were repeated by the writer in a series of six cases, but the results were unsatisfactory, as all six patients died.

GERSTLEY, Chicago.

THE POSSIBILITY OF CURING TUBERCULOUS MENINGITIS. KONRAD KOCH, München. med. Wchnschr. **72**:793-794, 1925.

Sixty proved cases of tuberculous meningitis with recovery are reported. The author reports a case in a boy, aged 9 years, who had had tuberculous spondylitis at 7 years of age. He fell from a chair and hurt his back one week before admission to the hospital, at which time symptoms of tuberculous meningitis were present. Tubercle bacilli were found in the spinal fluid. Three weeks later, the condition suddenly improved; after three months, the patient was dismissed without symptoms. The writer believes that in this case the trauma caused a dissemination of tubercle bacilli from the old focus. The only therapeutic procedure attempted was spinal puncture every second or third day.

SCROFULOSIS AND DENTAL CARIES. HANS JOACHIM THOLUCK, München. med. Wchnschr. **72**:794-798, 1925.

The writer emphasizes the importance of the proper care of the teeth in children. The enlargement of the cervical lymph nodes diminish decidedly after the teeth of the school children have received proper care by a dentist.

GROB, Rochester, Minn.

INVESTIGATION OF KIDNEY FUNCTION IN PATIENTS TREATED WITH SANOCRYSIN. N. C. LUNDING, Ugesk. f. Læger. **2**:30, 1926.

Tables are shown demonstrating that in general more than four or five injections (3.5 to 4.6 Gm.) of sanocrysin produce a marked decrease of kidney function. This decrease is evidenced by a fixation of the concentrating ability of the kidney, by the lowering of the thiosulphate excretion and by a decrease in the water excretion. The kidney injury is considered to be due to a heavy metal action.

SCHLUTZ, Minneapolis.

THE CAMPAIGN AGAINST TUBERCULOSIS IN EARLY CHILDHOOD. W. TOBLER BERN, Schweiz. med. Wchnschr. **55**:932 (Oct. 8) 1925.

The author points out that the struggle against the tubercle bacillus belongs to modern civilized life. As soon as the bacillus has entered the body, the struggle commences. Tuberculous infection occurs most frequently during the age of childhood.

Few individuals, especially those living in large cities, pass beyond the stage of childhood without having been infected with tuberculosis.

Hamburger has shown that about 95 per cent of Viennese children of the poorer class have commenced the battle against tuberculosis at 12 or 13 years of age. Ganghofer of Prague gives the same figures. He emphasizes the

fact that babies and small children suffering from pulmonary tuberculosis are particularly dangerous to people around them.

Klotz reports an instructive case of an infant, 1½ years old, suffering from pulmonary tuberculosis, who infected five other children.

The so-called cured adult case of pulmonary tuberculosis is frequently dangerous to the infant. The author has seen several cases of tuberculous meningitis in infants, contracted from a member of the family supposedly cured. He recommends that all nurses, maids, servants, etc., should be rigidly examined. Of course, the greatest danger is the tuberculous mother; nevertheless if she insists on nursing her child, by proper precautions the danger may be reduced to a minimum. He refers to Calmette's work on immunization by inoculation. From July 1, 1924, to June 1, 1925, 2,070 new-born infants in France and in Belgium were inoculated. In none was there any unfavorable symptoms. Of 137 inoculated children living in one district in which they were exposed to the greatest danger of infection, none died of tuberculosis, while according to Calmette under similar conditions in Paris, a mortality of 32.6 per cent would have been expected.

ELTERICH, JR., Pittsburgh.

VALUE OF THE WASSERMANN REACTION IN ACTIVE TUBERCULOSIS IN CHILDREN. T. KOYAMA and K. TANAKA, J. Pediat. (Tokyo), No. 304, 133 (Sept.) 1925.

The authors experimented on thirty-nine cases of active tuberculosis with the antigen which was prepared in the laboratory of Wassermann. They found that the reaction is positive in most of the cases, but they believe that the positive Wassermann reaction is not diagnostic of active tuberculosis.

KATO, Los Angeles.

Internal Diseases

INFANTILE THYMIC HYPERPLASIA. NORMAN M. MACNEILL, Arch. Pediat. **42**:821, 1925.

Thymic hyperplasia occurs in a large (40 to 50) percentage of new-born infants and represents a potential danger to life, particularly during acute respiratory diseases. Any abnormal respiratory symptom in the new-born or in early infancy should suggest roentgenographic treatment for enlarged thymus. Roentgen-ray therapy causes cessation of symptoms and retrogression of the thymus.

DIFFERENTIAL DIAGNOSIS OF DISEASES OF THE HEMATOPOIETIC SYSTEM. MARK S. REUBEN, Arch. Pediat. **43**:15, 1926.

In many cases of diseases of the blood-forming organs, the diagnosis may not be clear for a long time (two or three years), and then becomes apparent usually a short time before death. In a small number of cases, the diagnosis is not clear even at necropsy. In children, recovery from severe anemia may be very rapid and permanent. Features which connote severity in the adult have not the same significance in children.

Generally speaking, anemia in children who have a large spleen runs a more benign course than it does in those who have a normal spleen. When the liver alone is enlarged, the course is more severe. The leukemias in children cannot be differentiated so decisively as in adults. Lymphatic and myelogenous leukemia in many cases cannot be differentiated clinically. There may be no

splenic enlargement in the myelogenous type and no lymphatic enlargement in the lymphatic type. In these cases also, the course is more rapid in those in which there is only hepatic and no splenic enlargement, and more protracted in those which present considerable splenic without hepatic enlargement.

Every child under 2 years of age who complains of pain in the extremities in association with edema and marked pallor, should have repeated blood examination. Under 2 years of age, leukemia is more common than rheumatism. In Hodgkin's disease, skin manifestations may be the first signs of the disease. Priapism is sufficiently common to have diagnostic value.

Clinically, certain cases of purpura hemorrhagica, leukemia and Hodgkin's disease cannot be differentiated. The laboratory will clarify the diagnosis of the former and biopsy will differentiate the latter. In the great majority of cases the differentiation between hemophilia and purpura is simple. Both these types may not run true to form and occasionally cannot be classified in either group.

Jaundice which is present at birth, which increases in intensity and which is associated with clay colored stools and increased resistance of red cells, is usually due to obliteration of bile ducts. On the contrary, jaundice which is present at birth increases in severity and is associated with increased fragility of red cells is of hemolytic origin.

Cases in which there is tremendous enlargement of spleen and liver, in the absence of lymphatic enlargement, jaundice and ascites, are usually of the Gaucher type, especially if there be persistent leukopenia even when there is no anemia. A very large spleen and liver in association with general lymphatic enlargement in the absence of anemia, jaundice and ascites may be splenomegalia lymphatica hyperplasia and should receive the therapeutic test of roentgen-ray treatment.

The association of splenomegaly, hepatic enlargement and ascites, followed by atrophy of the liver should suggest Banti's disease. Every severe anemia in children should call for an examination of the stool for ova.

DIVERTICULI OF THE SMALL INTESTINE OTHER THAN MECKEL'S DIVERTICULUM. JAMES T. CASE, Bull. Battle Creek Sanitarium **21**:87, 1926.

In a series of 6,847 complete barium meal studies, characteristic evidence of duodenal diverticulosis was obtained in eighty-five cases, diverticulosis of the jejunum in five, and of the jejunum and ileum in one case. In order to facilitate the filling of the duodenal diverticuli with the barium, pressure was exerted over the duodenal-jejunal junction and the contents of the stomach was pressed toward the pylorus. The shadows cast are separate from the duodenum and persist for some time after the emptying of the stomach. Diverticuli occur most frequently in the second portion around the ampulla of Vater.

Clinically, diverticuli may be significant in association with ulcer, disease of the gallbladder or pancreas and cases of obstruction. In the second instance, the diverticuli may have caused swelling of the ampulla of Vater with subsequent dilatation of the sphincter of Oddi. During periods of insufficiency, infectious material from the duodenum may find its way even into the pancreatic or bile ducts. Obstruction may be caused by pressure of a filled sac against the duodenum. A diverticulitis may, in itself, be a discomfort and a danger.

When the fundus of the sac is located ventrally to the head of the pancreas or to the right side of the duodenum, surgical removal is comparatively simple. When it is dorsal to the head of the pancreas or within that organ, operation

is difficult and may be accompanied by serious complications. The position of the sac can largely be determined at fluoroscopy, and when feasible, the advisability of surgical removal should be considered. LESLIE, Chicago.

THE MEDICAL TREATMENT OF PYLORIC STENOSIS OF INFANTS. WILBURT C. DAVISON, Bull. Johns Hopkins Hosp. **37**:157, 1925.

In this series of thirty-two infants with unmistakable pyloric stenosis, treated medically, three died—a mortality of 9 per cent. These three patients were dying on admission, and were refused operation by the surgeons.

Two types of patients should be operated on before medical therapy is attempted. First, those infants with unmistakeable signs of complete pyloric obstruction; second, breast-fed infants whose mothers for any reason cannot nurse their children regularly.

Medical treatment consisted in giving enough breast milk at intervals of four hours to give the infant at least 100 calories per kilogram of body weight per day. The amount varied from 2 ounces at a feeding for an infant weighing 5 pounds (2.3 Kg.) to 5 ounces at a feeding for a child of 10 pounds (4.5 Kg.). If this feeding was vomited, an amount equal to that vomited was refed. If the refeeding was vomited, the stomach was washed and an amount equal to that vomited was left in the stomach.

The disadvantages of medical treatment of pyloric stenosis are the large amount of breast milk required, the prolonged stay in hospital, and the almost ceaseless work called for from the intern and nursing staff. The advantage is the reduction in the total mortality. LYTTLE, New York.

NOTES ON INFANTILE ASTHMA. J. COMBY, Arch. de méd. d. enf. **12**:739, 1925.

Comby discusses in this lengthy monograph, and in his inimitable style, the essential or idiopathic asthma of infants, referring to all other varieties as pseudo-asthma or asthmatiform syndromes secondary to various lesions of the respiratory tract.

He characterizes the true form, as did Trousseau before him, as a paroxysmal respiratory neurosis, entirely independent of organic injury or irritation. It is composed of two distinct elements, the spasm and the catarrh of which the former is the predominating element. In a review of 150 cases, he finds, in spite of the numerous theories advanced concerning the cause of asthma, and notwithstanding the many therapeutic adventures chronicled in recent years, that we have actually progressed very little and that empiricism still guides the clinician in the management of this most baffling affliction.

Comby covers fully the various features of its natural history, particularly its relation to other diseases, such as neuro-arthritis, eczema, migraine, urticaria, tracheobronchial adenopathy and pulmonary tuberculosis; the well known symptomatology is graphically portrayed, and the progress and prognosis of asthma receive the attention their importance warrants. He adds nothing new in treatment.

COLIPYELOCYSTITIS, COLIBACTEREMIA OR COLITOXEMIA OF INFANTS. M. MICHALOWICZ, Arch. de méd. d. enf. **12**:749, 1925.

Of 839 children treated at the Children's Clinic of the University of Warsaw from Jan. 1, 1921, to June 1, 1924, sixty-one, or 7.2 per cent, were found to be suffering from pyelocystitis. In the outpatient service, in which

4,927 children were treated during this period, seventy-three, or 1.5 per cent, had pyelocystitis. In the first group, there were 78 per cent female patients and in the second 90 per cent.

The author criticizes clinicians for continued failure to keep this disorder in mind in their examination of infants, citing his experience not only in hospital but in private practice. The disease is more common than usually considered. Michalowicz reviews the various theories now current concerning the mode of infection and expresses the belief that the etiology is more complicated than commonly supposed. One is struck by the fact that in this group of patients we have what may be termed "the external characteristics of pyelocystitis." The infants are pale, with sunken eyes, easily becoming fatigued, and possess markedly diminished powers of resistance to infection. Expecting to find corroboration of the tentative diagnosis, on examination of the urine, one is surprised to receive a negative report. Exhibition of methenamine, tropin and citrate of soda, alternately, usually brings about a marked amelioration of symptoms in a fortnight, when, on further examination, pyuria or bacteriuria is shown to exist. This observation, frequently repeated in Michalowicz' clinic, leads him to believe that there may be, antedating the pyelitis, a colipyemia in certain cases.

Other cases have been studied in which the clinical picture of colipyelitis was not borne out by urinary findings, but in which meningitis soon developed and the cerebrospinal fluid showed infection with the colon bacillus. The author argues from these facts that invasions of the colon bacillus in the general circulation and in the genito-urinary apparatus may exist, independent of each other. The difficulty of identifying *B. coli* in the blood is pointed out, and the advisability of cultures and inoculation experiments is suggested. Agglutination tests are also readily made.

Michalowicz believes the common avenue of infection is through the intestinal wall, following diminished resistance of the epithelium in various disease conditions, particularly the dyspepsias, and he dismisses, with slight discussion, any possibility of other organisms, such as streptococcus, staphylococcus and proteus, being concerned in the causation of the disease. He feels that *B. coli* alone should be indicted, and he believes, after summing up all the evidence available, that pyelocystitis is not a primary affection, but is secondary to some other disease such as grip or enteritis.

AMESSE, Denver.

THE NATURE OF SMITH'S SIGN IN CORRELATION WITH THE APPEARANCE OF VENOUS HUMS. H. BROKMAN and M. PROKOPOWICZ, Rev. franç. de Pédiat. **1**:439, 1925.

In 1875, Eustache Smith described the appearance of a venous hum heard over the sternum in children with enlarged tracheobronchial lymph glands. This is best heard when the child moves its head so that the face is in a horizontal position with the eyes regarding the ceiling. Smith's explanation is that the lower part of the trachea is displaced forward and upward, dragging behind it the glands placed in its bifurcation, which, if enlarged, in turn compress the left brachiocephalic vein.

From a study of cases checked by roentgen ray, the authors feel that the sign has no diagnostic value, and that the origin of the bruit is entirely different from that indicated by Smith. They state that it occurs in persons with peculiarly elastic blood vessels, and that it is due to the stretching and consequent narrowing of the lumen of the superior venous trunks when the

patient is in the upright position. The stretching is due to the weight of the heart and would vary directly with the mobility of the heart as well as with the elasticity of the vessel walls.

Among the facts presented in support of the theory are the following: 1. Whenever the sign of Smith is encountered, there is almost always to be heard a souffle over the jugular. 2. It is never detected in the recumbent position, no matter how the head is turned. 3. It occurs in persons with relatively low blood pressure. 4. It occurs most frequently between the ages of 7 and 10 years, and decreases with increasing age as the vessels become less elastic and the heart less mobile.

LESLIE, Chicago.

THE USE OF LOBELIN IN PARALYSIS OF THE RESPIRATORY CENTER DURING AN OPERATION. KURT HEMPEL, München. med. Wchnschr. **72**:808-809, 1925.

In a case of respiratory failure, the respiration was restored within two minutes by means of an intramuscular injection of 0.02 Gm. of lobelin. In this patient, an operation was performed in the neighborhood of the medulla. During the operation the breathing suddenly stopped. Artificial respiration was employed for ten minutes; 5 cc. of camphorated oil did not help to restore the breathing; 0.02 Gm. of lobelin was able to bring the patient back to life.

GROB, Rochester, Minn.

IDIOPATHIC OSTEOPSATHYROSIS. HERBERT RAU, Ztschr. f. Kinderh. **40**:77, 1925.

Rau reports a case of osteogenesis imperfecta in a boy, aged 14½ years, who had had at least twelve fractures and showed blue sclera, fragile veins and overextensible joints.

CONTRIBUTION TO THE TREATMENT OF PYLOROSPASM. H. HERZ, Ztschr. f. Kinderh. **40**:83, 1925.

Excellent results are reported by Herz in Schlossmann's Clinic in forty-five out of fifty-two cases of pylorospasm, treated with small, frequent feedings of human milk by bottle. The greatest importance is attached to especially equipped nurses, one of whom did not lose a single case out of nineteen.

EMERSON, Boston.

PROGRESSIVE MYOSITIS OSSIFICATION: A PATIENT TREATED BY KETOGENIC DIET. T. FRÖLICH, Acta Pædiat. **5**:294, 1926.

The disease commenced when the patient was 2½ years old. Multiple fibrous tumors developed in the muscles of the chest, shoulder girdle, back and arms. Some of these disappeared while others went on to ossification. Six months after the onset, the limitation of motion was such as to render the child a helpless invalid, unable to feed himself or to grasp objects. Roentgenograms showed large masses of bony tissue in the axillae.

The author's treatment was suggested by the observation that fractures in diabetic patients healed with great difficulty. In the hope that ketosis might exercise an unfavorable influence on the progressive calcification, a diet low in carbohydrate and high in fat was continued for a year and a half. Acetone bodies were constantly present in the urine and the carbon dioxide combining capacity of the plasma averaged about 35 per cent by volume. A few new nodules developed during the period of treatment, but their existence was quite transitory. A very striking improvement took place in the calcified areas.

Many of them disappeared entirely and others diminished greatly in size. The mobility of the head, trunk and extremities returned to such a degree as to enable the child to lead a perfectly normal life.

The author is somewhat skeptical as to the correctness of the theory on which his treatment is based, but he feels that these results, in a disease usually considered hopeless, are sufficient to warrant its further trial.

HEMOLYTIC CRISES IN CONGENITAL HEMOLYTIC JAUNDICE. LEIF SALOMONSEN, Acta Pædiat. **5**:309, 1926.

Two children in the same family with hemolytic jaundice are reported. Both developed at the same time a severe hemolytic crisis with rapidly increasing anemia, jaundice and urobilinuria. Transfusion was necessary in one case. Regeneration of blood after the crisis was almost as rapid as the previous fall. It was noteworthy that during the phase of progressive hemolysis the color index was low, while during the period of regeneration the color index was 1 or greater. The spleen was removed in both children with some clinical improvement.

One child showed the interesting complication of obstructive jaundice in addition to the hemolytic jaundice. The stools became clay colored and bilirubin appeared in the urine. At the time of operation this condition was still present, but nothing abnormal could be found in the gallbladder or bile passages. The author thinks that thick inspissated bile was probably responsible for the obstruction.

HOLT, Baltimore.

HYPERPLASIA OF THE MESENTERIC GLANDS. AAGE SENNELS, Ugesk. f. Læger. **51**:1125, 1925.

This is a report of 114 cases which were clinically diagnosed as appendicitis but which, on operation, showed only enlarged mesenteric lymph glands. One hundred and three of these patients had attacks simulating acute appendicitis. In both sexes the largest number of cases occurred from the eighth to the fifteenth year of age, but the condition was also very frequent in young women between 17 and 25.

In a follow-up of the patients, the author found that 75 per cent were entirely free from their previous symptoms and appeared to be benefited by the appendectomy. Although several cases were studied in detail, no explanation is offered as to the cause of the glandular hyperplasia.

SIX SIMULTANEOUS CASES OF CRETINISM IN LUNDBY. OLINE CHRISTENSEN, Ugesk. f. Læger. **5**:103, 1926.

The history of six cases of endemic cretinism occurring in a valley in Denmark is presented. Four of these cases occurred in one family. One case occurred in a family who were subsequently tenants in the same house, and the sixth case occurred in the neighboorhood.

The probable cause is not discussed, although it would appear from the article that the water supply was at fault.

SCHLUTZ, Minneapolis.

RHODAMINURIA. S. MIURA, J. Pediat. (Tokyo), No. 304, 183 (Sept.) 1925.

The author saw a patient whose chief complaint was pink, shiny urine. The specimen of urine was florescent and the parent was asked whether the child had eaten any food which was colored red or pink. It was found that

a piece of candy stained red was taken a day or so before. On examination, both physical and chemical, this substance in the urine was identified as rhodamine B. Rhodamine is used chiefly in dying silk and wool in industry, and in medicine it is used as a constituent of blood stain, and its clinical significance has not been noted. Hence the term "rhodaminuria."

CORPUSCULAR SEDIMENTATION REACTION IN DISEASES OF CHILDREN. T. KATAOKA, J. Pediat. (Tokyo), No. 304, 192 (Sept.) 1925.

In tuberculosis, the acute form has a greater sedimentation speed than the chronic form. In convalescence from epidemic cerebrospinal meningitis, from diphtheria, from Heine-Medin's disease and encephalitis, there is no increase in its speed. In empyema after operation, it is accelerated. In glioma of the eyeball, it is greatly increased. In complicated cases of pertussis, it is also accelerated. It is also increased in acute febrile diseases, including catarrhal croup, laryngeal diphtheria, and dysentery.

KATO, Los Angeles.

Nervous Diseases

THE TREATMENT OF ANTERIOR POLIOMYELITIS. F. H. EWERHARDT, Arch. Physical Therapy **7**:196 (April) 1926.

The treatment of anterior poliomyelitis after the acute stage is discussed in this article. Stress is placed on the careful examination of the patient, in order to determine the actual degree of paralysis and muscle weakness. Only by so doing is muscle fatigue and muscle stretching avoided. Exercise, at first passive and later active, is discussed in a general way, bearing the foregoing in mind. The use of heat, massage and electricity are considered concerning their value during the convalescent period in increasing the general nutrition of the muscles and the nerve tissue.

Mention is made of the value of class work in getting these children to cooperate. The carrying out of movements and exercises given by command aids in restoring the neuromuscular complex.

CHAMBERLAIN, Chicago.

CONCERNING THE RELATION OF GUANIDINE TO PARATYROID TETANY. J. B. COLLIP and E. P. CLARK, J. Biol. Chem. **67**:679, 1926.

The authors do not believe guanidine formation is the cause of tetany in thyroparathyroidectomized dogs, because the urea curve and nonprotein nitrogen curve of the blood of dogs following thyroparathyroidectomy is different from those of dogs that had received injections of guanidine compounds.

INVESTIGATIONS IN TETANY. PAUL DRUCKER and FRANS FABER, J. Biol. Chem. **68**:57, 1926.

Experiments on children with tetany showed that:

1. The hydrogen ion concentration and alkali reserve of the blood are essentially the same as in normal children and are unchanged after the tetany is cured.

2. Calcium chloride is more efficacious than ammonium chloride in raising the blood calcium.

3. Monosodium phosphate and disodium phosphate act to lower the blood calcium and aggravate latent tetany.

4. General irradiation using a quartz lamp is quite efficacious in obtaining a permanent cure of tetany.

The authors believe alkalosis is not the explanation of infantile tetany. They present physicochemical evidence that the blood in tetany is not saturated with calcium, although following light treatment it becomes so. Phosphates by mouth probably aggravate tetany by withdrawing calcium from the blood into the bowel. Calcium chloride is of value in tetany both by reason of its calcium content and of its acting as an acid.

HIGGINS, Cincinnati.

CASE OF CHOREA WITH EXTENSIVE VASOMOTOR DISTURBANCE. R. HUTCHINSON, Proc. Roy. Soc. Med., Section for the Study of Disease in Children **19**:6 (Nov.) 1925.

A boy, aged 10½ years, had an attack of rheumatism associated with chorea. He recovered in four months, but later had a relapse of the chorea. From the onset of the affection, his fingers and toes were persistently blue, with considerable mottling of the skin. There was no heart lesion. Blood calcium and phosphorous were both normal. The Wassermann reaction was negative. There was no sign of any angioneurotic condition in the other members of the family. The cyanosis of the fingers and toes was present for twenty-two months. It was unaffected by heat and it developed at the same time as the rheumatism and chorea.

AMYOTONIA CONGENITA. ERIC PRITCHARD, Proc. Roy. Soc. Med., Section for the Study of Disease in Children **19**:10 (Dec.) 1925.

The author reports a case of amyotonia congenita in an infant, aged 3 months. He also reports a case of hemiatrophy in an infant aged 1 year. The question is whether asymmetrical development on the two sides of the body means hypertrophy of the one side or atrophy of the other. The patient, the author noticed, sweated profusely on the atrophied side and excessive sweating is presumably a pathologic symptom, and it would be curious if this pathologic symptom should be confined to the normal side.

WILLIAMSON, New Orleans.

ACUTE PSYCHONEUROSIS IN CHILDREN. JOSEF K. FRIEDJUNG, Ztschr. f. Kinderh. **40**:126, 1925.

The author reports five cases of children, previously well behaved, who became suddenly very difficult to manage, and believes that the change can be explained on the basis of the work of Freud. An unexpected change of a beloved nurse, for example, may lead to otherwise unexplainable irregularities in defecation or micturition.

EMERSON, Boston.

PEROXIDASE REACTION AND EPIDEMIC ENCEPHALITIS. S. NAGAI, J. Pediat. (Tokyo), No. 304, 163 (Sept.) 1925.

The authors found that the Sato-Sekiya peroxidase reaction becomes negative on the leukocytes obtained after injecting bouillon intraperitoneally, only after the blood presents negative reaction to the Sato-Sekiya peroxidase test in animals in which punctures have been made successfully for this purpose.

PEROXIDASE REACTION AND EPIDEMIC ENCEPHALITIS. S. NAGAI, J. Pediat. (Tokyo), No. 304, 165 (Sept.) 1925.

Using the same technic as described by Sato and Sekiya, Nagai obtained negative peroxidase reaction in epidemic encephalitis. He also reports that in his studies of blood of birds and healthy normal rabbits, the peroxidase reaction is more frequently negative than positive, and consequently he doubts the diagnostic value of the so-called peroxidase reaction.

EXPERIMENTAL AND CLINICAL STUDY OF LOCATING THE BRAIN LESIONS BY MEANS OF BLOOD PICTURE. AKIRA SATO, J. Pediat. (Tokyo), No. 304, 174 (Sept.) 1925.

It has been found since the first report on the diagnostic value of peroxidase reaction in locating the brain lesion, that when peroxidase reaction is negative while the oxidase reaction remains positive, the brain lesion is located on both sides of the corpus striatum, including the lenticular nucleus, nucleus dentatis, nucleus ruber and substantia nigra. This same reaction holds true in the typical cases of epidemic encephalitis involving the paralysis of ocular muscles. This phenomenon is now given a new term of "striatal blood symptom."

KATO, Los Angeles.

Diseases of the Eye

FAMILIAL OCCURRENCE OF MELANOSIS BULBI. E. M. SELTER, Monatschr. f. Kinderh. **31**:587, 1926.

This is a clinical report of four cases of pigmentation of the ocular conjunctiva. The pigment appeared bilaterally and was in the course of blood or lymph vessels. It lay immediately around the cornea. Cases of this sort have been described before, but the author believes these of special interest because they occurred in two generations of the same family and were transmitted through the father.

GERSTLEY, Chicago.

Diseases of the Ear, Nose and Throat

CONGENITAL STENOSIS AND ATRESIA OF THE EXTERNAL AUDITORY CANAL. G. POLITZER and E. G. MAYER, Virchows Arch. f. path. Anat. **258**:206, 1925.

In eight cases studied there were found anomalies of the tympanic portion of the petrous bone, which was hypoplastic hyperplastic or aplastic. The time of origin of the developmental anomaly is placed in the second to third fetal month. The described anomaly is much more frequent in females than in males. Of the reported cases of atresia, the condition was bilateral in 28.5 per cent, left sided in 21 per cent and right sided in 50.5 per cent.

O. T. SCHULTZ.

ADENOIDISM AND ABNORMALITIES IN THE CONFORMATION OF THE NASAL SEPTUM AND THE UPPER JAW. PASQUALE RUSSI, Supplement to Arch. ital. d. otol., rinol. e laringol. **2**:1-79, 1925.

In subjects with adenoids, abnormalities in the conformation of the bones of the face are: 1. Malformations (deflections, spurs or spines of the nasal septum, and, in the upper jaw, an ogival, often asymmetric, palate) nearly always due to general causes that affect the regular development of the fetus

(syphilis, rickets). Malformations of this class range in gravity all the way from insignificant manifestations to the various kinds of harelip and cleft palate. 2. Malformations due to disturbances manifested in extra-uterine life and resulting either from general causes (lymphatism, scrofulosis) or from local causes, among which adenoid growths play the principal part. Malformations of this class may affect only the septum and the upper jaw but not necessarily both. While ogival palate may not be invoked as the sole cause of deflections of the septum, it is without doubt the principal factor. Deflections of the septum, ogival palate and abnormal arrangement of the teeth (dental ataxia) were found associated in 9 per cent of the cases studied. Ogival palate was associated with deviations of the septum in 43 per cent of the cases. Adenoidectomy restores completely nasal respiration impaired merely by the hyperplastic pharyngeal tonsil. But in subjects who present deflections of the septum or marked thickening or hypertrophy of the turbinates the same benefit is not produced. Sometimes, several months after adenoidectomy, beneficial modifications in the ogival palatine arch and in the dental arches may be observed.

WOLCOTT, Chicago.

Diseases of the Skin

A STUDY OF AN EPIDEMIC OF IMPETIGO IN NEW-BORN INFANTS. LLOYD B. DICKEY, Arch. Pediat. **43**:145, 1926.

An epidemic of eighteen cases of impetigo in infants is reported, occurring chiefly among the new-born infants in the obstetric nurseries, with a known incidence of 34.8 per cent. Cultures from the blebs showed growth of *Streptococcus fecalis, Staphylococcus aureus* and *Staphylococcus albus.* Many solutions, utensils and articles were found contaminated with the same type of organisms. These organisms will grow and remain alive in tap water, 4 per cent boric acid solution, albolene and soap, for various periods of time.

Realization of the true method of spread, with proper precautions to prevent it, will result in a greatly reduced incidence of infection.

VON MEYSENBUG, New Orleans.

ERYTHEMA NODOSUM. ARVID WALLGREN, Acta Pædiat. **5**:225, 1926.

Wallgren believes erythema nodosum to be an allergic manifestation of tuberculosis, occurring (1) with the first development of allergy after a primary infection, or (2) on the reappearance of allergy after measles or certain other diseases. An impressive array of clinical data is presented in support of this contention. Very frequently he finds a positive tuberculin test associated with an attack of erythema, whereas a short time before the skin test had been negative. Injections of tuberculin, which might be expected to increase hypersensitiveness, sometimes induce an attack of erythema nodosum.

There seems to be an individual, a familial and perhaps a racial susceptibility to this particular type of skin lesion. Patients who exhibit it are apt to have a benign form of tuberculosis, usually confined to the mediastinal glands.

HOLT, Baltimore.

TREATMENT OF FAVUS WITH PETROLEUM AND ITS PRODUCTS. M. D. HORST, Nederl. Tijdschr. v. Geneesk. **1**:1286, 1926.

In treating a case of favus which had lasted for years with sambol, the author obtained good results. He now describes the good effect of the treat-

ment with sambol or with crude Kansas petroleum, which contains a large amount of sulphur. In this way he treated thirty cases of favus, all established microscopically, and a case of trichophytosis. The treatment lasted six months or longer. Its advantages are that epilation is not necessary, so that the treatment can be carried out at home. General hygienic measures are necessary with the oil treatment.

VAN CREVELD, Amsterdam.

Surgery and Orthopedics

ADNEXA IN INGUINAL HERNIA. W. N. ROWLEY, Am. J. Obst. & Gynec. **10**:709, 1925.

Herniation of the adnexa in the female infant is comparatively rare. The case report is of a herniation of the left ovary and tube into a right hernial sac, with the cystic degeneration of the ovary.

SPONTANEOUS RUPTURE OF SARCOMA OF THE OVARY: REPORT OF CASE. HARRY KOSTER, Am. J. Obst. & Gynec. **10**:716, 1925.

Out of 118 cases of sarcoma of the ovaries in children, Dr. Koster's case is the only one complicated by spontaneous rupture. He thinks the rupture was probably due to hemorrhage into the soft sarcomatous tissue.

There was a large early metastasis in the left side of the neck that had been treated under the diagnosis of glandular tuberculosis. The patient died two months following the removal of the sarcoma.

ALLEN, Chicago.

ACUTE INTUSSUSCEPTION IN CHILDREN. W. L. HARRIS, Arch. Pediat. **42**:811, 1925.

Intussusception is not so rare that any general practitioner should not be familiar enough with it to recognize the condition when it is seen. The acute conditions are the ones that cause death quickly unless promptly recognized. The treatment is surgical and never medical.

TORSION OF OVARIAN CYSTS IN CHILDREN. MARK S. REUBEN, Arch. Pediat. **43**:54, 1926.

Cysts of the ovary are not infrequently found in children under 10 years of age. They occur at birth and during the first year. They may assume large proportions without symptoms. The symptoms for which a physician is usually called in these cases are due to torsion, suppuration or rupture. The symptoms are often mistaken for those of appendicitis. There are no urinary symptoms but cystitis and pyelitis are very often associated. Owing to high mortality on account of prevalence of malignancy in young children, excision of the cyst should be advised in every case.

VON MEYSENBUG, New Orleans.

TWO CASES OF NEPHROLITHIASIS IN CHILDREN. S. SIMONS, Nederl. Tijdschr. v. Geneesk. **1**:1290, 1926.

In the first patient, a girl, aged 5 years, the only symptoms were attacks of hematuria after the first year. The roentgenogram demonstrated a large stone in the right pelvis. In the second patient, a boy, aged 9 years, the patient suffered from attacks of nonradiating pain in the right part of the abdomen,

accompanied by hematuria. In the right ureter there was a small stone and in the left pelvis there were several small stones. Each day, both children received 30 Gm. of glycerol in a mixture, with an equal part of water and a small quantity of citric acid. Soon after the beginning of this therapy the boy passed the stones.

VAN CREVELD, Amsterdam.

Miscellaneous

MERCUROCHROME-220 SOLUBLE AND GENTIAN VIOLET. THEIR EXPERIMENTAL USE INTRAVENOUSLY. W. J. PENNOCK and CHARLES FERGUSON, Northwest Med. **25**:39 (Jan.) 1926.

Pennock and Ferguson injected 8 mg. of mercurochrome-220 soluble and gentian violet in 1 and 0.4 per cent solutions, respectively, into half grown rabbits by the intravenous route. The rabbits were bled aseptically at five to forty-five minutes after injection, and the serum of this blood was separated, slanted and coagulated. On these serum slants, implantations of *Staphylococcus aureus, B. coli and B. prodigiosus* were made. As the organisms grew luxuriantly on all of the slants, the authors concluded that these dyes have no bacteriostatic or bacteriocidal properties as used under the described circumstances.

SCOTT, Philadelphia.

THE PRESCHOOL AGE. FRANK R. DEW, Ohio State M. J. **22**:130, 1926.

Attention is called to the need of examination for the correction of defects in first grade school children, and the opportunity for improvement by doing much of that work in the preschool age. An earnest plea is made for justice in immunizing children against smallpox, diphtheria, and scarlet fever in the preschool age or earlier. A law is asked compelling examination for defects and proper immunization before school age. Meanwhile the author advocates health commissioner clinics during the summer months for children of this age. A table for the years 1922, 1923 and 1924 gives cases, births, and mortalities, and thus shows the improvement due to such work.

HORTON, Columbus, Ohio.

PROBLEMS TO BE CONSIDERED AT THE NEXT SESSION OF THE ADVISORY COMMITTEE ON THE PROTECTION OF CHILDREN AND YOUNG PEOPLE. Rev. Internat. de L'Enfant, Geneva **1**: (Feb.) 1926.

The second number of this official journal of the League of Nations presents, in a most attractive and interesting editorial, the problems to be considered at the next session of the advisory committee on the protection of children and young people, to be held at Geneva on March 22, 1926.

Although the complete agenda of the session have not yet been issued, reports on at least six important medico-sociologic matters will be received and discussed. These include:

1. The study of the laws concerning the protection of life and health in early childhood.

2. Compilation of laws relating to the age of consent and to the age of marriage.

3. Draft international convention for the relief or repatriation of alien children who are either abandoned, neglected or delinquent.

4. Child labor.

5. Family allowances.

6. Effects of moving pictures on the mental and moral development of the young.

Other topics to be offered for general debate at this session are: *a*, recreation; *b*, training in biology; *c*, delinquents; *d*, alcoholism; *e*, education of the young in principles of international cooperation.

An illuminative paper on "The School of Creative Education in Switzerland" is contributed by M. Ad. Ferriere, director of the international bureau of "new" schools. Dr. C. W. Saleeby makes an earnest plea for the universal use of iodized salt in the campaign against goiter in childhood. Dr. Wilhelm Hertz discusses feelingly the problem of the unemployed boys and young men in Germany. The prevention of tuberculosis among the apprentices of Austria is taken up by Dr. Fritz Rager.

Brief reports are published from various countries of the League outlining recent measures adopted for the amelioration of conditions surrounding child life in Europe, together with a complete bibliography of the literature bearing on these subjects. Several full page illustrations lend added interest to this valuable review.

AMESSE, Denver.

ETIOLOGY OF THE DISEASES DURING THE FIRST DENTITION. E. FEER, Schweiz. med. Wchnschr. **55**:817 (Sept. 3) 1925.

The author claims that the profession is still divided regarding this question. Wichman, in 1797, insisted that the majority of so-called dentition diseases do not exist and are dependent entirely on insufficient diagnostic ability. Great credit is to be given to the Viennese pediatricians, Fleischman, Politzer and Kassowitz, who unreservedly denied the existence of "Dentitio difficilis."

After careful consideration and review of the subject, the author concludes that, up to the present time, there is no proof of any diseases of dentition, except rare and slight disturbances in the mouth, and there is also a very strong probability that these never exist.

ELTERICH, JR., Pittsburgh.

Society Transactions

CHICAGO PEDIATRIC SOCIETY

Regular Meeting, March 16, 1926

GEORGE E. BAXTER, M.D., *President, in the Chair*

HEMORRHAGIC NEPHRITIS. Presented by DR. J. K. CALVIN.

A boy, aged 9, first seen by a physician when he was 7½ years old, had acute hemorrhagic nephritis following an upper respiratory infection. A year and a half after the condition began, he was brought to the hospital, the chief complaint being bloody urine. Cystoscopic examination showed blood coming from the left kidney. There was much blood in the urine, a moderate number of leukocytes, 1 + to 2 + albumin, and an average number of casts. Various tests were made to rule out other kidney pathologic changes, such as tuberculosis, tumor, etc.; guinea-pig inoculations were negative for tuberculosis. A skiagraph showed a rather large kidney but no stone. Because there was blood coming from one ureter Dr. Kolischer performed a decapsulation of the left kidney about one year before this report was written, and found only the signs of hemorrhagic nephritis. Following this, the urine became negative while the child was still in the hospital, but three months later it again began to show albumin and an occasional blood cell. When the child was presented the urine was the same as before the operation, while that from the right kidney was absolutely normal. The boy was in fairly good health, attended school and showed no signs of other pathologic changes.

Dr. Calvin cited the work of Marriott and Claussen of St. Louis, who, because of their investigations, believe that hemorrhagic nephritis is accompanied by a general infection of the capillaries of the body. They have found the capillaries in other parts more numerous and more tortuous. The kidney, being so vascular, is the part most affected. Dr. Calvin thought if this assumption was correct, both kidneys should be involved although not necessarily to the same degree.

POSTORBITAL HEMORRHAGE IN NEW-BORN INFANT. Presented by DR. MARK JAMPOLIS.

A child, with a normal family history, was normal except that the right eye was more prominent than the left. This was noticed immediately after birth, and since then it had become more prominent. There was no inflammation, but protrusion of the eyeball was present.

DIABETES INSIPIDUS. Presented by DR. A. LEVINSON.

A boy, aged 10 years, was admitted to the hospital on Feb. 4, 1926, with the complaint of frequency of urination, enuresis and involuntary urination of six months' duration. The urine was measured, and was found to vary between 4,000 and 5,000 cc. in twenty-four hours. The specific gravity varied between 1.002 and 1.007. The urine contained no sugar or albumin. Diabetes insipidus was suspected.

The mother gave a history of one miscarriage and had a 4 plus Wassermann reaction. The patient's blood gave 1 plus positive reaction with cholesterol antigen on one occasion, but when repeated it was negative. A skiagram showed the sella turcica to be negative. The spinal fluid was normal in amount and pressure, and the Wassermann reaction was negative. There was a hypoglycemia, the blood sugar being 59 mg. per hundred cubic centimeters one time, 72 another time and 81 mg. after treatment with pituitary extract. The spinal fluid sugar was 56 mg. per hundred cubic centimeters. The thirst was so great that the boy had to have large quantities of water.

The condition was thought to be one of diabetes insipidus, with the possibility of syphilis as the background, because of the positive Wassermann reaction on the mother's blood. Sulpharsphenamine was tried but no favorable results were obtained. From 7 to 10 minims of surgical pituitary extract given hypodermically reduced the thirst and the urinary output. Smaller doses had no effect, nor did pituitary extract given sublingually.

TETANY AND VOMITING. Presented by DR. I. HARRISON TUMPEER.

An infant, aged 6 months, was brought to the hospital because of convulsions. It was the seventh child in the family. The eldest had convulsions at 6 months of age with no recurrence. The patient had been breast fed irregularly, which feedings had been supplemented by Eagle Brand and other forms of condensed milk. Orange juice had been given occasionally but no cod liver oil. Before admission to the hospital the baby had an upper respiratory infection, with fever and three convulsive seizures. There were no convulsions and no fever after admission. The findings included tetanic posture, pot belly, squart head, craniotabes, and positive Chvostek, Trousseau and Erb signs. The blood calcium was 4.3 mg. per hundred cubic centimeters. The diagnosis was tetany.

This typical case of what might be termed skeletal tetany is presented in order to introduce the subject of the less typical, more speculative, visceral tetany.

OSTEOMYELITIS. Presented by DR. HARRY JACKSON.

The cases were grouped in three classes: 1. The very acute types with profound toxemia, in which the patients have died within forty-eight to seventy-two hours. 2. The type with pain localized in the long bones, in which the patients remain in the hospital for many months after operation. 3. The unusual cases.

A girl, aged 7, came into the hospital with a temperature of 101 to 102 F., and signs of a small abscess in the right vulva (?) which was opened and drained. There was pain, tenderness and swelling in the region of the left knee, ankle and hip, and the child could not bend the knee or ankle. The swelling was so marked around the ankle that a needle was put in but nothing was found. Roentgenograms were negative. After the patient was in the hospital for about two weeks, the condition in the ankle and knee cleared up, but the hip remained swollen. Examination revealed destruction of the head of the femur, which persisted until it involved the upper third of the bone. On operation, raspberry-like material was found, which contained a staphylococcus similar to that obtained in the vulva. Rat inoculations showed the same organism.

In another case the patient had been in the Presbyterian Hospital the previous year, and came into the Sarah Morris Memorial Hospital with what

was said to be a cyst of the tibia, with jelly-like material which contained large numbers of giant cells.

Three different lesions of the bone in children have been diagnosed either as bone cysts, benign giant cell tumors, or chronic osteomyelitis. These patients had demonstrated all of these stages, which led Dr. Jackson to believe that all of these conditions are stages in one process. If the case is seen when there is destruction of the bone, it is called a bone cyst. If there is tissue overgrowth they are called benign giant cell tumors, and in the later stage they are called chronic osteomyelitis. If a patient is seen early and followed for several months, all the stages of the process can be seen.

The patient who was exhibited had had an intercurrent scarlet fever and the osteomyelitis became worse. She had improved since then and was ready to go home, with a caliper splint to be used until the bone was strong enough to maintain her weight. The involved bone had been removed and the wound packed with iodoform gauze. The child was being built up with cod liver oil, calcium and tonics, with some massage, passive movements and therapeutic light treatment, and was doing well.

LUNG ABSCESS. Presented by DR. RALPH BETTMAN.

Case 1.—A boy, aged 15, who had developed a lung abscess at the age of 9, had been troubled ever since because of foul sputum. He was presented to show what surgical operations can do for such patients. The entire lower lobe of the left lung and part of the upper lobe had been removed from the back. The heart could be seen beating through the wound under the left shoulder blade. He had been well and working since the operation. The fetor oris which made him a social outcast had entirely disappeared. The wound which remained was to be closed by a simple plastic procedure. The case proved that removal of one or two lobes of the lungs is feasible and will cure such conditions.

Case 2.—A child, aged 7, was receiving treatment for empyema by the closed method. Some pus was still being aspirated from the tube every two hours, and solution of chlorinated soda was injected to dissolve the fibrin flakes.

The case was shown to allow the emphasis of the following points: (1) A case of empyema can never be considered cured until the empyema cavity is obliterated; (2) the obliteration of the cavity occurs when the lung has reexpanded; (3) the closed method of treatment never allows the lung to collapse, as in the open method, but, on the contrary, from the first aspiration the lung starts its reexpansion. For every cubic centimeter of pus aspirated the lung must expand to take its place.

CYSTIC HYGROMA. Presented by DR. ETHEL DAVIS.

This child was first seen at the age of 6 weeks, because of a tumor mass which involved the neck, the axillary and pectoral regions. This mass had been present since birth, but the mother thought there had been a slight decrease in size. The condition was so extensive that expectant treatment was decided on. The child had received two or three radium treatments, with little or no effect on the tumor mass. Some of the smaller masses had disappeared, but the main tumors were about the same as before treatment. Dimpling was present over the tumor, which caused them to think that malignant degeneration was taking place.

THYROID INSUFFICIENCY. Presented by DR. O. RAGINS.

A girl, aged 13, has been a dispensary patient at Michael Reese Hospital from the age of 2. Up to the age of 9, there had been no suspicion or symptoms of thyroid insufficiency recorded. After that age she began to put on weight. At the age of 11 she weighed 119 pounds (54 Kg.). Her pulse was 62, she was sluggish in her movements, her skin was coarse and dry, her hair thick and dry and her voice husky. Her intelligence was good. The basal metabolism was 37.5 below normal. Desiccated thyroid treatment was begun, beginning with ¼ grain, gradually increasing to 1½ grains three times a day. Within two months she lost 18 pounds, and her pulse came up to 82 but the basal metabolism remained below normal. Treatment was stopped and within a month she regained 8 pounds. When treatment was reinstituted she again lost weight. In February, 1926, it was decided to hospitalize her in order to ascertain the maximum dose of thyroid she would tolerate. In the hospital the dose of thyroid extract had been gradually increased to 2½ grains three times a day and the child lost 20 pounds within three weeks. The basal metabolism went up to 28 above normal, and the pulse was above 100 on several occasions.

It is a question in this case whether the child will ever regain her normal thyroid function.

ECCHYMOSIS. Presented by DR. DAVID B. WITT.

Two brothers, aged 9 and 16, respectively, had shown either ecchymotic areas in the skin or slight hemorrhages. The 9 year old boy had been admitted to the hospital two and a half weeks previous to this, because he had vomited blood on two occasions. There was weakness, loss of appetite, discoloration of the skin over the nose and other areas of ecchymosis. After he had been in the hospital for a week, one of his playmates in the ward jumped on him, which evidently caused a little internal injury, for the urine was quite bloody on the following day, which condition persisted for two weeks. Coagulation time was eighteen minutes, bleeding time two and one-half minutes on entrance, but this had been reduced to eight and to one and one-half minutes, respectively. The family history was typical of hemophilia. Three of the mother's brothers had died of hemorrhage following slight operations, and the maternal grandmother had two brothers who were bleeders. Of eight children in the patient's family, four had died; one from hemorrhage following circumcision, one from an accident, one from pneumonia and one from whooping cough. Attempts were being made to reduce the coagulation time by administering the father's blood, by thromboplastin and by calcium lactate.

ASTHMA; HIVES; ECZEMA (?). Presented by DR. R. I. HILLER.

Case 1.—A girl, aged 5½, suffering with bronchial asthma, was found to be sensitive to eggs, turnips and celery. She was placed on a milk diet, on which she improved and left the hospital. Afterward, she attended the dispensary for five months at intervals of two weeks because of a respiratory infection, and was sent to the hospital for study and for tonsillectomy. As soon as she was admitted she had attacks of asthma and bronchitis. After eating some salad containing celery she developed an attack of hives. Rhinitis with profuse nasal discharge was noted a few days later. The blood showed an eosinophilia of 2 to 4 per cent. Roentgen-ray examination revealed clouding of the sinuses, and following drainage she was perfectly comfortable. On a restricted diet she had made a good recovery.

Case 2.—A girl, aged 12, was admitted to the hospital in June, 1924, because of asthma and bronchitis and was found to have cloudy antrums. Following drainage, the condition improved considerably. This child also proved to be sensitive to eggs, and after being put on a diet free from eggs, she left the hospital in a fairly comfortable condition. However, she soon became subject again to asthmatic attacks, and at the time of presentation showed all the signs of advanced asthma with emphysema; the sinuses at this time were not pathologic.

These cases were presented to show two types of protein influence in the production of asthma, one due to an external stimulant such as food, and the other to an internal stimulant such as toxins absorbed from a focus of infection.

DECEREBRATE RIGIDITY. Presented by DR. ALVIN M. WINOGRAD.

A girl, aged 9 months, was brought to the hospital with a history of loss of ability to sit, stiffening of the extremities and failure to hold the head erect for the past month. The child was said to have been normal until she was 8 months old. There had been no convulsions, but there was a tendency to stiffen the limbs and throw the head to one side or the other, and to lie in an outstretched position. There was a history of an instrumental delivery, but no cyanosis or convulsions followed delivery. Hydrocephalus was present; the head was large, with a large fontanel, there was increased pressure of the spinal fluid, which was otherwise negative, and secondary optic atrophy. The legs were kept extended, the feet were constantly extended, and there was marked rigidity. The deep reflexes were increased, a positive Babinski sign and a positive Magnus-de Kleijn sign were present.

The condition of decerebrate rigidity has been produced experimentally in animals by Pollock and Davis, and by others, and an analogous condition can be produced by supracellar cysts or tumors of the midbrain. Tumors compressing the pyramidal tracts of the midbrain interfere with the motor control, and decerebrate rigidity develops.

The Magnus-de Kleijn tonic neck reflex is seen by turning the chin to one side, producing extension and increased rigidity of the arm and leg on the side to which the head is turned with flexion and relaxation of the opposite arm. The rigidity in this condition is plastic or "clasp-knife" in character.

Wilson believes the red nucleus to be the center of decerebrate rigidity. By destruction or isolation of the red nucleus in animals, the picture mentioned in the foregoing has been produced experimentally.

FURTHER OBSERVATIONS ON CHOREA. Presented by DR. J. R. GERSTLEY.

About two years ago, Dr. Gerstley gave a brief report of his work in chorea with the Rosenow serum. He showed that repeated throat cultures showed no particular type of streptococcus, nor did the serum show any specific agglutinating properties. From this he concluded that there was nothing specific about the serum, and that as yet it showed no great clinical value.

Recently, he had reviewed the cases of chorea from a clinical standpoint, particularly from that of the tonsils. He divided a series of twenty-eight cases into two groups: one, that in which the tonsils had been removed before the child came to the hospital, and the other that in which the tonsils were removed during the stay in the hospital. In this series, fifteen of the children had their tonsils removed before entering the hospital. Of the remaining thirteen, the tonsils were removed after the chorea had improved. The operation had no

effect on the immediate symptomatology or on the course of the chorea. There was no difference in the complications of those children who had the tonsils removed before entering and those who had them removed in the hospital. Complications and recurrences occurred in equal numbers in both groups, and chorea developed in children without tonsils more frequently than in those with tonsils. As a result of this study, Dr. Gerstley believed more discrimination should be shown in removing the tonsils in chorea.

SUBCUTANEOUS EMPHYSEMA. (PATHOLOGICAL SPECIMEN.) Presented by DR. PHILIP ROSENBLUM.

A child, aged 7 days, on the day of admission to the hospital suddenly had an attack of cyanosis and difficult breathing, and died within an hour. A diagnosis of bronchopneumonia and emphysema was made before death and was confirmed by necropsy. A skiagram showed the air going up into the neck as far as the mandible. Subcutaneous emphysema is not common, but the interstitial variety is frequently seen.

Pathologic report by Dr. Schultz: The pleural cavities were free of fluid and adhesions. When the chest was opened a large amount of air escaped. Soft, areolar tissue of the anterior and posterior mediastinum was distended with air having the appearance of numerous large bullae or air vesicles. Both lungs presented large areas of consolidation on the posterior surface. The outer surface of these areas was dark purple, and in it were isolated bits of lung tissue which were gray and emphysematous. The cut surface of the lung through the area of consolidation was a dark reddish gray, rather fleshy, from which a very small amount of fluid could be expressed and which was practically airless. The picture was very patchy.

In children, subcutaneous emphysema is most frequent in bronchopneumonia of measles, whooping cough and tuberculosis. An attack of coughing in these conditions may cause rupture of dilated alveoli or bronchi, weakened by inflammation. In other cases air pressure may be increased by partial obstruction of bronchioles by exudate, causing rupture of the weakened wall.

Air reaches the mediastinum as it escapes from the lungs, then to the tissues of the neck by the incisura jugularis. The prognosis depends on the underlying condition. Puncture of the skin should not be done, as infection and usually fatal cellulitis set in.

Book Reviews

DISEASES OF CHILDREN. By the late SIR JAMES FREDERIC GOODHART. Edited by George Frederic Still. Twelfth Edition. Pp. 966. Philadelphia: Lee & Febiger, 1925.

For a book to go through twelve editions may be regarded in itself as prima facie evidence of its merit. Hesitation to recommend it unreservedly to the student and to the practitioner is due to rather numerous shortcomings, some of which may be pointed out here.

Under "Arsenic" on page 14, the author states "children of the upper classes, who, like their parents, are much more sensitive to medication than are hospital patients (a physiological fact of which there is no doubt, and of very wide bearing indeed)." It is possible that such a statement is correct, but if we take into consideration the individual variations in reactions to drugs and the inability of changing such action objectively in many instances, we must object most seriously to such ex cathedra statements without references to actual data.

The observation that in some new-born infants an increase of coagulation and bleeding times is observed is worth noting. The omission of a discussion of tube feeding in certain premature infants as well as in certain infants with harelip and cleft palate is serious.

In the discussion of ailments due to dentition, this passage occurs: "Increased activity of all the physiological processes at work necessarily implies greater risks of friction between one organ and another, or even of a regular break-down. Excessive energy, if not properly regulated or adequately expended, is liable to lead to an explosion of some sort or another." To the reviewer, such a statement in a textbook is painful, to say the least. In dentition, lancing of the gums is mentioned as a therapeutic measure. The author might better omit the illustrative example of Mr. Nunn who, by the lancing of the gums, apparently arrested more than one case of epileptiform convulsion occurring during second dentition. In the discussion of anorexia, oncoming dentition seems "to cast its shadow before" for weeks. The author also associates laryngismus stridulus with dentition.

The biochemistry of the book is poor. Human milk has "a neutral or faintly alkaline reaction to litmus (to the more delicate reagent, phenolphthalein, the reaction of human milk is faintly acid)." The reaction of the milk is stated correctly; however, that has nothing to do with the delicacy of the indicator, but with its range. Lipase is said to split milk fat into glycerine and butyric acid. The effect of sodium citrate on the calcium of the milk, its rôle as a source of alkali in the organism, is not clear to the author.

In discussing "Fever with Digestive Disorders," oranges are accepted as acid food. After numerous experiences with protein milk and lactic acid milk, it is very peculiar to read about the difficulty of casein digestion. Under these conditions, it is no wonder to find the author stating, "The calorimetric method makes no discrimination between the calories derived from this and that constituent of food." As one can talk of a calorimetric method of feeding, it must be kept in mind that the earliest writers clearly stated that fat and carbohydrate can replace each other isodynamically to a certain extent, but that they cannot replace the protein. Such statements are nearly sufficient to condemn a chapter on nutrition, and infant feeding is but a subdivision of this problem.

Under "Wet Nursing," it is stated that "unless there is a strong reason for supposing syphilis to be absent, the blood should be tested for the Wassermann reaction." We are accustomed to demand this as a matter of routine, but we also try to protect the wet nurse against the possibility of being infected by a syphilitic infant, a point not mentioned here. The modern successful practice of protein milk feeding or of high caloric feeding in cases described under "marasmus" makes valueless such statements as "Educated on faulty principles, as it has been, the stomach adheres to them, with pertinacity, or becomes so irritable that even proper feeding does not seem to suit, and the child can only be saved by the most patient and attentive, even quick-witted, regulation of its diet."

In considering flatulence and proneness to constipation in infants, it is stated, "It is by no means an uninteresting subject for study how far such idiosyncrasies foreshadow the temperament of after-life — the nervous or phlegmatic, for example." Such remarks may please the behaviorist, but there are much more pertinent subjects of study in pediatrics.

Under the heading "Coeliac Disease," sufficient stress has not been laid on the necessity of avoiding carbohydrate, particularly at the onset of the disease and in the selection of the proper ones later.

In the discussion of "Fever with Digestive Disorder" we find "Sometimes the temperature will run up quite suddenly at night and come down again, and remain normal after the following morning, apparently in obedience to a febrifuge, but quite as likely in dependence upon what may be called the initial vitality of the fever." In this chapter, as elsewhere, the importance of parenteral infections in relation to gastro-intestinal symptoms might be treated. The illustrative cases certainly impress one as typical of parenteral infections. The diagnosis of hypertrophic pyloric stenosis is based on "the palpable thickening of the pylorus and the well marked visible peristalsis of the stomach." The student had better not lay too much stress on palpating the thickened pylorus. If the infant is not already too exhausted, a trial, for a few days, of such food as raw meat juice and white wine whey or very very weak peptonized milk is recommended. Medical treatment should be attempted, but the most important measure to be tried is feeding with thick cereal. This procedure, as well as atropine treatment, might be mentioned. Preoperative preparation, such as transfusion, of a debilitated infant should be included.

In the treatment of thrush, no mention was made of the boric acid bag. In cases of harelip and cleft palate the proper preparation for operation is too important to be overlooked. "Acute ulceration of the tonsils is not uncommon in children as the result of bad hygienic conditions and exposure to sewer gas, and ulcers from this cause may be either superficial or deep." This is somewhat difficult to understand.

The blood culture might have been suggested as a valuable aid in early diagnosis of typhoid fever. In a discussion of tuberculosis in children, Ghons' work should not be omitted. Laryngismus stridulus is treated separately from tetany. With regard to tetany, the author states that "we do not even know that the calcium balance is impaired." The diminution of calcium in the blood is a rather well established fact.

The paragraph on Graves' disease needs revision, as does that on simple goiter. Under diseases of the liver is included something called "lithaemia" which might better be left out. No cognizance of pituitary extract is taken under the treatment of diabetes insipidus. In discussing pyelitis, it might be

well to emphasize the necessity of the demonstration of micro-organisms by urinary culture and the dangers in the persistent forms should be pointed out, as well as the reasons for persistency. The newer work on functional albuminuria or postural albuminuria has been thoroughly neglected. The omission of phenobarbital from the discussion of treatment of epilepsy is a serious oversight.

THE HEALTH OF OUR CHILDREN. VOL. V. THE DEVELOPMENT AND HYGIENE OF THE CHILD. By DR. CARLOS DE LOS TERREROS. Madrid, España: Renacimento, San Marcos 42.

In this volume of a series of treatises on "The Health of Our Children" by Spanish writers, the author deals with the age periods of early infancy, childhood and adolescence. The physical and psychic changes which the child undergoes in transition from period to period are pointed out.

The importance of the diet is stressed. It must not be onesided. During the age of 3 to 7 years, 75 per cent of the substances fed must come from the vegetable kingdom and 25 per cent from the animal kingdom. From the age of 7 to 12 years, about 30 to 35 per cent animal matter must be given and the rest vegetable substances. Eggs are regarded as a valuable food, but much less important than milk. There should be a great deal of variety in the food.

The author shows that most alimentary intoxications occur from spoiled foods, and also that most infections can be introduced into the body by way of the intestinal canal. As the author tersely puts it, "A child, like a fish, dies in most instances through the mouth."

The old conception, that dentition is the cause of many disorders, is maintained. Tonsillectomy and adenoidectomy are advised if there is any indication, mechanical or otherwise. The importance of well lighted and ventilated rooms is stressed; also the importance of proper clothing. The author believes thoroughly in respiratory gymnastics, and advocates daily practice of same.

The complete wellbeing of the child, expressed by the Greek word, "euphoria," is attained through the influence of three important factors; namely, good air, sunlight and outdoor exercise. Fatigue shown by these euphoric children does not affect or depress their spirits as does fatigue affecting the child kept indoors. The fatigue of study and close application is best relieved by play outdoors. The author lays great stress on proper posture, and in this connection warns against the danger of fatigue.

There is an excellent chapter on the hygiene of the nervous system of the child, and a particularly good and comprehensive chapter on the qualifications of a children's nurse. The final chapter deals with the duties and obligations of the mother to her child, to its teacher and to its doctor. In its small and compact size, this little volume is remarkably comprehensive, and contains a fund of valuable information for the layman.